INTERVIEW: INTELSAT DIRECTOR GENERAL IRVING GOLDSTEIN

AUSTRALIAN communications

DECEMBER/JANUARY
1992-93

The Data and Telecommunications Management Magazine

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BUYING A WAN THIS CHRISTMAS?

We unwrap solutions from nine networking vendors

DEFENCE COMMUNICATIONS

How Australia's defence forces keep in touch

THE LAN SUPERBOX

Get ready for the combination hub, bridge, router, switch . . .

DISTRIBUTED SYSTEMS

Why you shouldn't overlook mini-based networks

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BUYING A WAN 63

In our December/January edition last year Brian White compared six wide area network solutions put forward in response to a Request For Information for a fictitious company named AusComms Pty Ltd. This year we've done it again, only in an even bigger and better way. AusComms now has a whole new set of requirements and we've selected solutions from nine networking vendors — 3Com, Ascom Timeplex, Bull, Com Tech Communications, Interlink Communications, NetComm, Retix, Sun Microsystems and Ungermann-Bass — for comparison. How do they stack up? This month we publish Part I of Brian's article analysing their responses; Part II in next month's edition will provide a close look at the specific functions provided by each solution as well as discussion of the networking issues involved.

DEFENCE COMMUNICATIONS 75

Sophisticated surveillance and command and control techniques now employed by the Defence forces produce a vast amount of data — all of which needs to be transmitted somewhere in a secure and preferably high speed fashion. But despite the high-gloss appearance of jet fighters and up-to-the-minute frigate designs, Stewart Fist has discovered that our Defence forces still communicate at data-rates first achieved on international commercial cables in the late 1800s. But, change is now at hand and communications is now seen as equal in importance to logistics in maintaining fighting efficiencies at the front line. As a result, Defence communications is now moving out of the telex and ticker-tape era and joining the rest of the world in the communications revolution.

DISTRIBUTED SYSTEMS 83

Conventional wisdom has it that a PC-based solution makes for the most efficient and cost effective distributed system. But is that really so? Even the most bigoted PC evangelist has to admit that there are times when a computing task is simply beyond a PC-based system. Conversely PC-based distributed systems can perform many of the tasks traditionally assigned to a minicomputer or small mainframe. When is a minicomputer-based system more cost effective than one based on PCs? To find out, Graeme Le Roux has put together three typical distributed system scenarios and pitted a solution from Digital Equipment Corporation against an equivalent offering from the product lines of Compaq, Microsoft and 3Com.

Australian Communications has moved. Our new address is →

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DECEMBER/ JANUARY 1992-93

TOKEN RING BRIDGES 93

As the latest round of tests by the Data Comm Test Lab show, remote Token Ring bridge performance is improving. They conducted similar tests last year and discovered some alarming discrepancies between vendor claims and product performance. But now just about every bridge/ router could use all the bandwidth offered by high speed lines when working with the large packets typically used for file transfers. However, it's still not time to relax. Vendors have yet to come up with a way to ensure that their bridges always get critical data to its destination, especially when low-speed WAN lines become congested. The ideal remote Token Ring bridge would be a plug-and-play box that network managers could deploy without worry and end-users would never know is present.

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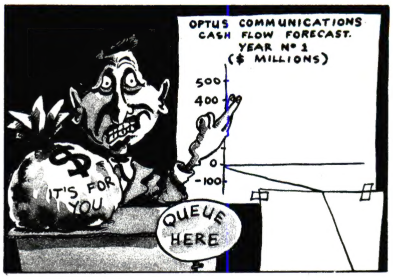
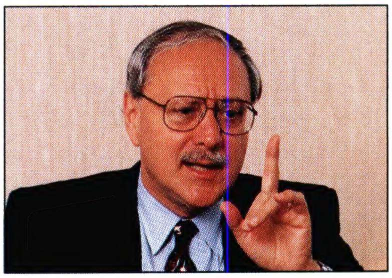


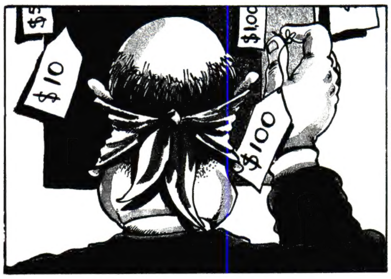
INTERVIEW

57 Irving Goldstein
Previously Chairman and CEO of US satellite company Comsat, Mr Irving Goldstein was elected Director General of Intelsat in December 1991. In Australia last month for the 18th Intelsat Assembly of Parties, he spoke to Liz Fell about Intelsat's future.



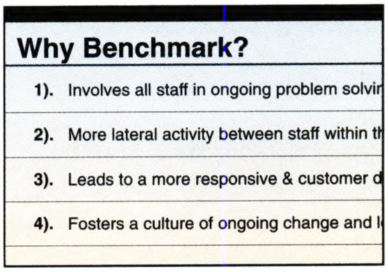
LEGAL LINE

55 Radio Communications Reform
The Government has laid down a radical new structure for radio frequency spectrum management. Peter Leonard takes a close look at the background to the reforms, how they might be implemented and the problems that may arise as a result.



MANAGEMENT

103 Benchmarking
What is benchmarking and how does it lead to better management? In the first of a new series of columns, Brian White examines benchmarking and how it can be applied to communications management. Properly used, it can lead to big improvements.



Why Benchmark?

1). Involves all staff in ongoing problem solvi
2). More lateral activity between staff within t
3). Leads to a more responsive & customer d
4). Fosters a culture of ongoing change and l

OPINION

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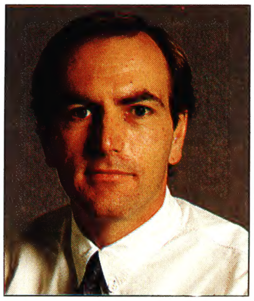
Buying the AusComms WAN



This month's issue contains the first installment of our second 'AusComms Buys a WAN' feature article (the first appeared in our December/ January 1991-92 edition). In it, Brian White provides a first pass look at the solutions put up by the nine Australian networking vendors involved in this year's project: 3Com, Ascom Timeplex, Bull, Com Tech Communications, Interlink Communications, NetComm, Retix, Sun Microsystems and Ungermann-Bass (see 'AusComms Buys a Data Network,' starting on page 63). Next month, Brian will present a much closer feature-by-feature look at the specific functions provided by each solution as well as a full discussion of the internetworking issues involved.

Like last year, this year's article stems from a project extending over several months and involving close cooperation from the vendors concerned. It involved the issuing of a Request For Information (RFI) document on behalf of AusComms Pty Ltd detailing the company's current data processing environment and future networking goals. Also like last year, without the cooperation and professional commitment from the vendors involved to take time out to provide a real-world response to a set of fictitious requirements the project would still be stuck very firmly on the drawing board.

Can an article in a magazine provide a complete picture of the solutions available? Can it identify the 'best' wide area network solution on offer? The answer to the first question must, realistically, be no. WAN design issues are too numerous and difficult (and often unique to the would-be buyer) to be satisfactorily explored in a single article. The many, many implications of a whole swag of details deliberately left unspecified for the sake of brevity in the AusComms RFI dictated a similar broad brush response from the vendors. Although in more than a few cases we were overwhelmed with the effort and obvious time put into the responses, even in those cases it's simply impossible to provide a full description of each solution for reasons of space alone.

The answer to the second question must also be negative. In a field as complicated as this, a 'best' solution can only be determined with close reference to a set of detailed requirements as would be contained in a Request For Tender. AusComms only issued an RFI and as such, information on many important comparative benchmarks — such as pricing — were left unrequested.

So why have we gone to the trouble for the second time of putting together an article based on the requirements of AusComms? In the twelve months since last year's article was published we've had a constant stream of requests for copies and more information. It's clear to us that any attempt to draw together the strands of wide area networking and provide a framework within which many of the networking issues discussed in these pages each month can fit is very much a welcome and worthwhile exercise.

M A Smeaton

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With Digital's new WorkGroup Networking Family you get flexibility that goes beyond changing the

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*Supports FOIRL and 10Base-FL standards.

communications modules. You also get support for today's multivendor work styles.

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Either way, the entire family supports multiple wiring strategies and media, and connects easily to FDDI. And each repeater, bridge, and server is fully compliant with 10BaseT and 10Base2 standards. That means they'll work with **ANY SYSTEM**, not only VAX computers and DECnet networks.

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PRODUCT HIGHLIGHTS

DECserver 90L + (DSRVG)

- Quick set up and use.
- Uses efficient LAT protocol.
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- Supports out of band management (RS232 port).

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Preselection Deal Sealed as Optus Long Distance Starts

The sealing of a preselection agreement, the commencement of Optus' long distance call service and the first hint of acrimony between the carriers last month signalled the beginning of real competition in the Australian communications industry.

Announced in mid-November, the preselection 'agreement' (it was brokered by Austel and DOTAC and reached only after an Austel directive to do so) provides for series of ballots to commence after mid-1993. The ballots, which will be held progressively on a regional basis until 1997, will ask subscribers to nominate their carrier of choice. Subscribers may change their mind after choosing and — reportedly — those that don't vote will remain Telecom customers by default.

Optus introduced its long distance service on November 15 for subscribers in Melbourne, Sydney and Canberra. CEO Bob Mansfield predictably hailed the introduction as a great success but actually urged subscribers not to make calls until they received Optus information packs. To be mailed to all addresses in the three cities, among other things these packs will contain an explanation of Optus' tariffs. And on the early experience of competition, any tariffing explanations will be welcomed.

While Optus was launching its service Telecom announced a new plan to time long distance calls by the second by year's end and promoted its 'Family and Friends' long distance service by running advertisements outlining the circumstances where its rates were the cheapest. The fact that these ads were too complicated for most to bother with didn't dissuade Optus from putting out a prompt statement labelling them 'misleading.' Telecom responded by levelling the same 'misleading' charge at Optus' tariff comparison.

AOTC Posts 'Solid' Financial Results

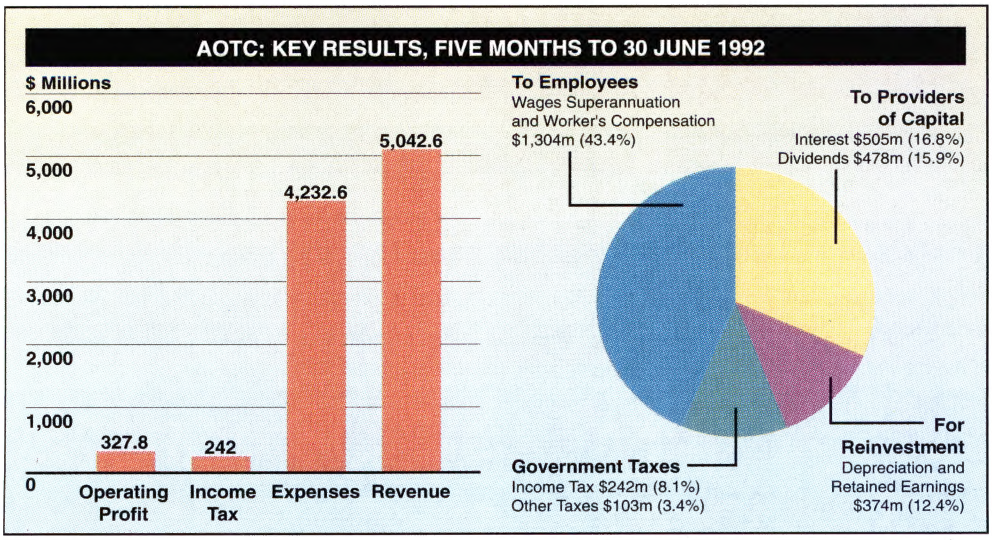
Despite the recession and falling tariffs AOTC has reported an 8.7% increase in revenues together with an improved return on assets in its first annual report released last month. The report, which covers the period February 1 to June 30, reveals revenues of $5,042.6 million and profit after tax of $327.8 million.

AOTC Chairman, Mr David Hoare, characterised the result as a "solid financial performance" which was achieved with the help of tight control of expenses. In fact, expenses before abnormal items rose by 7.9% to $4,233 million against the combined Telecom/OTC performance for the comparable period last year. After-tax operating profit before abnormals was $474.1 million, which, when annualised, represents a 13.7% return on assets compared to 12.2% for Telecom/OTC in the same period last year.

Mr Hoare said the AOTC Board had now proposed a final dividend to the Government of $263 million, which would bring the total remittance for 1991-92 to $478 million. Total payments to the Commonwealth Government for the reported period, which includes dividends, taxes, interest and loan repayments, reached $1,415 million.

AOTC Chief Executive Officer, Frank Blount, stated in his Forward to the annual report that to create AOTC profound and far reaching changes were being made to every facet of the former Telecom/OTC. Every aspect of the company was being appraised in order to meet the competitive challenge.

He also said that particular attention was being paid to improving AOTC's long term financial position. AOTC's debt portfolio at the end of the period stood at $8,922 million and in May, the international rating agency Moody's reduced its rating for AOTC senior unsecured Australian dollar denominated bonds. Mr Blount said that the present pre-tax interest cover of 2.4 times and a debt ratio of 47% are "acceptable at present," but will need to be improved.


AOTC: KEY RESULTS, FIVE MONTHS TO 30 JUNE 1992

Photonics CRC Established

Australia's participation in the emerging industry of Photonics, the control, manipulation, transfer and storage of energy and information using photons, received a large boost with last month's opening of the Australian Photonics Cooperative Research Centre (APCRC) at the University of Sydney.

The APCRC combines the resources of the Optical Fibre Technology Centre at the University of Sydney, the Photonic Network and Systems Centre at the University of Melbourne and the Optical Sciences Centre at the Australian National University. In terms of funding, it is the largest of the CRCs so far established with over $75 million committed up to 1999. Of that amount, the Federal Government will provide nearly $27 million while over $40 million will be provided by the Centre's participants, including AOTC ($2 million per annum), the Australian Computing and Communications Institute, the CSIRO, NEC, Pacific Power, Siemens and Fibernet.

The Centre will be headed by Dr Mark Sceats, from the University of Sydney. Dr Sceats attributed the Centre's success in attracting funding to its strong support from industry. The companies involved will "provide the link between the research and the market and will help Australia to capture some of the growing world market in photonics," he said.

Optus Union Deal Ratified

The Industrial Relations Commission has ratified an Enterprise Agreement between Optus Communications and the Communications Workers Union.

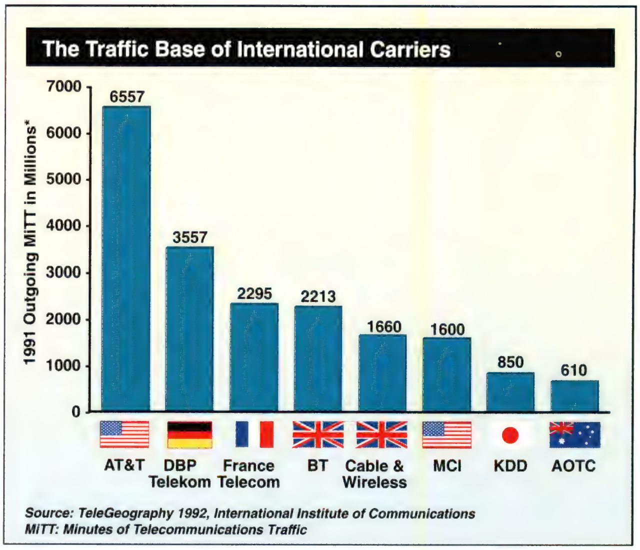
Optus claims the Agreement moves away from the 'rights and obligations' focus of awards and eliminates 'staff' and 'employee' distinctions. For instance, all Optus employees will participate equally in the company's superannuation scheme.

Global Telecoms Continue to Boom

Global telecommunications traffic is continuing to boom despite the worldwide recession according to a new report by the UK-based International Institute of Communications (IIC).

Telegeography 1992, which contains statistics on the growth rates of the world's top 40 carriers in 1990 and 1991, reports that global traffic reached 35 billion minutes in 1991 — an increase of 13% over the 1990 figure. For 1992, the total volume of telephone and fax traffic is expected to amount to 40 billion minutes, around 19% of which will be carried by US carrier AT&T. Germany's DBP Telekom will rank as the next biggest international carrier with around 10% of the calls followed by France Telecom and British Telecom with around 6-7% of the market each.

However, the report reveals that competition is now cutting into the market shares of the largest national carriers. US-based MCI's international traffic base grew by 35% between 1990 and 1991, while the UK's Cable & Wireless grew by 29% during the same period.



The Traffic Base of International Carriers

Source: TeleGeography 1992, International Institute of Communications
MITT: Minutes of Telecommunications Traffic

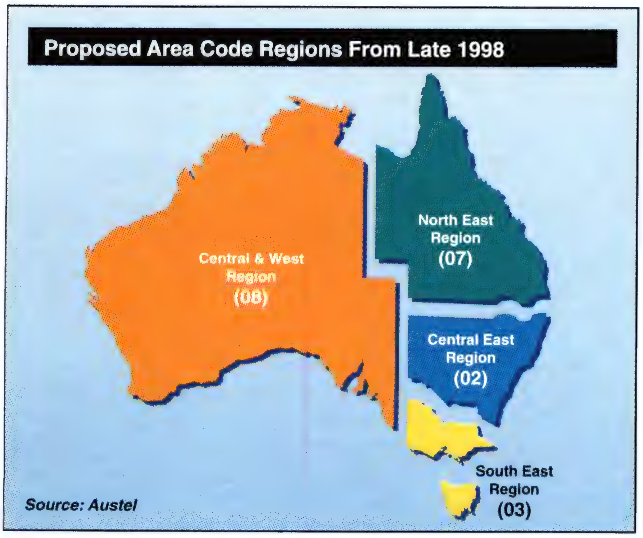
Austel's New Numbering Plan

Austel has released its draft plan to change Australia's telephone numbering system for public comment. To be implemented from 1994, the plan proposes to standardise all numbers to an eight digit local number plus a two digit area code and to reduce the current 54 area codes down to four regions by 1998.

Releasing the plan, which follows the mildly controversial *Your Number's Up* discussion paper, Austel Chairman, Robin Davey, said that Australia is running out of numbers. "The existing plan's shelf life has expired. It served us well, but time has passed it by," he contended. Formulated in the 1960's, that plan has now been overtaken by the advent of new services, competition and demographic changes.

Under its new plan, Austel has proposed that metropolitan numbers will be retained but be preceded by one additional digit. For example, Austel's Sydney number would change from (02) 893 9182 to (02) 9893 9182. As well as receiving a new area code, in most cases non-metropolitan directory numbers will be extended to include the first two digits of their existing area code. For example (085) 47 1111 under the proposal will become (08) 8547 1111.

The four new regional codes would consist of: (02) for the Central East (NSW and ACT); (03) for the South East (Victoria and Tasmania); (07) for the North East (Queensland); and (08) for the Central and West (WA, SA and NT).



Proposed Area Code Regions From Late 1998

Source: Austel

Telecom Ends Fujitsu PABX Deal

Telecom has moved to wind up its PABX marketing relationship with Fujitsu in favour of placing increased emphasis on its CustomNet intelligent network offerings.

Bill Wood, National General Manager of Telecom's Corporate and Government Business Unit, said that the change would take place over several months as the carrier moved towards concentrating on consultancy and service. He said the decision reflected changing business and technological realities. Telecom will now move to establish relationships with all manufacturers able to add value to the intelligent network. Support for Telecom-badged PABXs in operation will be maintained.

Fujitsu Australia Managing Director, Neville Roach, claimed that the company was "very enthusiastic about entering the Australian PABX market in our own right."

Sydney-Based Global VAN Launched

Saturn Global Network (SGN), a new international value-added network headquartered in Sydney and servicing 30 cities in 12 countries was officially launched last month.

A subsidiary of UK-based money brokers MW Marshall, SGN will provide voice and data network services through an Ascom Timeplex infrastructure used by its parent. These services include digital voice connectivity where SGN claims to be able to offer savings of over 30% through the use of voice compression techniques.

Drew Kelton, SGN General Manager, said that SGN will provide a full end-to-end service and covered all Australian capitals except Darwin and Hobart. Both AOTC and Optus house international gateway nodes for the company in Sydney, and there are two Sydney-based network management centres. SGN network management centres are also located in London and New York, he said.

Kelton said that parent company MW Marshall will take up around 40% of SGN's capacity. MW Marshall is 29.5%-owned by British Telecom.

Drew Kelton

In Brief

David Hoare has been reappointed AOTC Chairman for a further three years following his original appointment in December 1991 for one year. Transport and Communications Minister, Senator Bob Collins, made the announcement noting the headway that had been made with the integration of OTC and Telecom.

British Telecom has announced that its ExpressLANE frame relay service is now available between Sydney and eight international destinations. BT say the service will support X.25 gateways, dial-up and high speed access up to 2.048Mbps.

DEC has announced the worldwide launch of DECfax Mail, Australian-developed software which allows DEC equipment users send faxes by e-mail. Developed at the company's Lane Cove facility, DEC says it could earn Australia $30 million in exports.

JNA Telecommunications has announced a joint design and development agreement with Italian group, Alenia SpA, where both companies will adapt and develop JNA's telecommunications equipment platforms to meet the needs of the Italian market.

Radio Frequency Systems recently won two export contracts valued at about $500,000. The Melbourne-based company will supply specialised radio antennas to Indonesia and Mexico. RFS also recently won accreditation to the AS3901 quality standard.

Consultel recently won a contract with the Posts and Telecommunications Corporation (PTC) of Papua New Guinea to develop market strategies for its services. The PTC is installing Alcatel System 12 switches, first in Boroko and Lae, and then nationally.

Austel has been asked by Transport and Communications Minister, Senator Bob Collins, to report on emerging technologies for the delivery of wireless personal communications services. The report is scheduled to be completed by mid-1993.

Com Tech Communications was recently named by leading US network vendor SynOptics Communications as its International Partner of the Year. Com Tech won the award over 80 SynOptics' resellers and distributors worldwide. Product volume, commitment to and understanding of SynOptics products, training, support services and market development were all considered.

AWA has awarded a $300,000 R&D contract to the University of Wollongong's Centre for Information Technology Research. The contract is to expand the capability of AWAnet FDDI II multimedia switch by providing high speed network interconnection.

GPT will provide the Sydney Water Board with what the company claims is the first ISDN-based virtual private network in South-East Asia. The 17-node network will be installed in early 1993.

Cisco Systems has reported a 99% rise in net sales for the quarter ending 25 October 1992. Net sales rose to $US126.4 million compared with $US63.5 million in 1991, while net income increased 115% from $US15.5 million to $US33.2 million.

Bull HN has recently bought the assets of HiSoft Computer's Customer Services and Advanced Services Divisions. Bull will offer approximately 45 positions to former HiSoft employees.

AT&T, Paxus and Qantek recently signed a joint venture agreement to form a new company, AT&T EasyLink Services Australia. The new company will provide global messaging and information services to the Australian and New Zealand marketplace, with particular emphasis on EDI, facsimile and e-mail.

Siemens has reported a boost in both employment and profits in Australia and New Zealand. Sales for the financial year ending 30 September 1992 stagnated at $217.1 million, but profit after tax rose 16% to $7.3 million. Employment rose by 167 to 1,179.

Standards Australia and DOTAC recently signed a Memorandum of Understanding whereby Standards Australia will produce new radiocommunications standards. The prime requirement is to align new Australian radiocommunications standards with similar international standards where they exist.

AT&T Network Cable Systems has announced a marketing agreement with Honeywell Communications Systems. The companies will market AT&T's Intelligent Building Cabling Distribution Systems in conjunction with Honeywell systems in energy management, safety, asset protection and building automation.

Loading cable on board the CS Vercors at Port Botany

PacRimEast Another Step Nearer

PacRimEast, the 7,700km submarine optical fibre cable network linking New Zealand to Hawaii and on to North America moved a step closer to reality in November when the cable-laying ship *CS Vercors* commenced laying 3,600km of Alcatel TCC-manufactured cable from Takapuna Beach near Auckland.

The *Vercors* was due to reach American Samoa by late December where its cable will then be joined with a 4,100km cable manufactured by AT&T.

Due to be operational by February 1993, PacRimEast is being laid at an average depth of 6,000 metres and has 28 repeaters joined at 124km intervals.

Alcatel TCC's Port Botany (NSW) plant is supplying approximately 11,000kms of cable for the PacRim network in a $500 million contract. In March 1994, a Cable & Wireless-owned ship will take on board over 7,000km of Alcatel-manufactured cable for PacRimWest linking Australia with Guam.

Pay TV at Last?

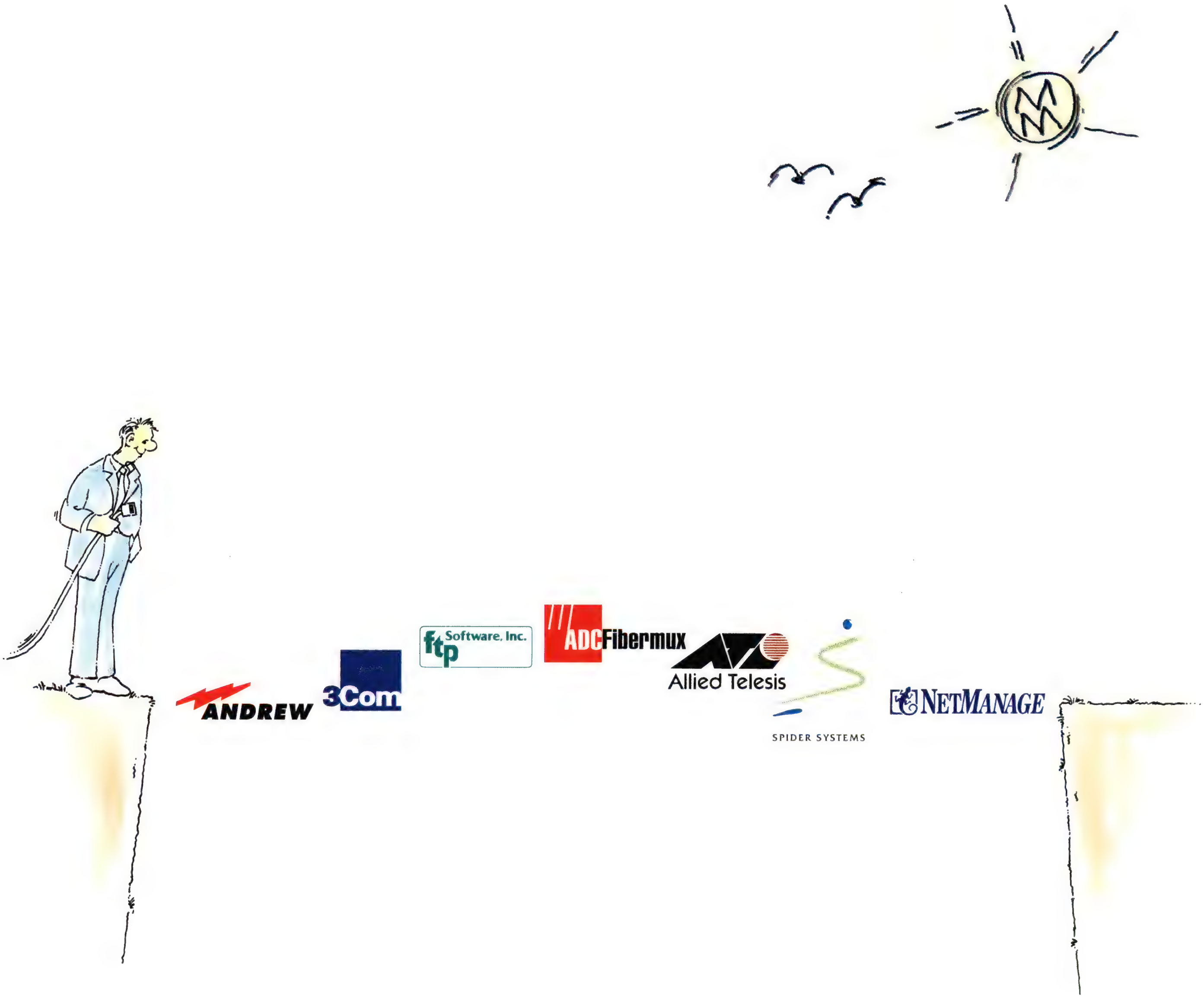
After years of indecision, it now looks as though the Government may have finally have arrived at a Pay TV model for Australia. However, because of a decision to mandate the use of digital compression technology for the delivery of Pay TV via Optus satellites, Australia may not see any services until 1996.

Transport and Communications Minister, Senator Bob Collins, announced last month that the Government will now legislate for the introduction of a 10-channel digital Pay TV service to be delivered. Two classes of licence (each for four channels) will be issued: Class A licences, which will be subject to cross-media ownership restrictions; and Class B licences, which won't. The ABC will probably get the two remaining channels.

NSW — The Telecoms State?

The NSW State Government has launched a programme to attract $10 billion in investment to the State's information technology and telecommunications (IT&T) industries by 1995. But apart from underlining that it's a good idea, NSW State Development Minister, Peter Collins, has offered little in the way of a concrete plan of action.

Formulated with input from more than 90 IT&T equipment and service providers, the programme is part of a wider plan to turn Sydney into the Asia-Pacific's major business centre after Tokyo. Mr Collins highlighted Optus' decision to locate in Sydney together with AOTC's NSW investment plans as building blocks for the programme.



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In Brief

Sprint has announced that its frame relay switching technology will be used by value-added network service providers in the UK, Sweden, Germany, the Netherlands, Belgium and Israel. Sprint also announced the availability of its public frame relay service to the UK, which will be based on its UK access node.

Mercury Communications, the UK operator, can now provide ISDN service to AT&T in the US, Canada, Hong Kong and Bermuda. Connections to France, Germany, Australia and Switzerland are scheduled for the next six months.

Telecom Corporation of New Zealand has recorded a 2.9% drop in pre-tax profit to $NZ262.4 million in the six months to September 30. Total operating revenues fell by 5% to $NZ1.22 billion. Revenue from national and international calls fell 13.8% and 6.2% respectively against the same period in 1991.

Siemens has signed a $19 million contract with Swedish Telecom International and Deutsche German Bundespost Telekom whereby it will install two submarine optical fibre links and appropriate on-land transmission equipment between Germany and Sweden. To be completed by October 1993, the cable will enable data to be transmitted over the Baltic Sea at 622Mbps.

Inmarsat has awarded a $US36 million contract to DB Salyut of the Russian Federation to launch an Inmarsat-3 satellite on a Proton rocket from Daikonur Cosmodrome in Kazakhstan at the end of 1995. It also signed a $US62 million contract with Arianespace of France to launch another Inmarsat-3 satellite in 1995.

Unisource, the joint venture between PTT Telecom Netherlands and Swedish Telecom, is expanding its frame relay network using switches from US operator, US Sprint. It is expanding to cover France, Norway, Denmark, Finland, Italy, Spain and Switzerland. Further global coverage will be offered during 1993.

Swedish Telecom says it will be among the first operators to install Synchronous Digital Hierarchy transmission throughout its entire network. It has awarded a SEK100 million contract to Ericsson with the aim of lowering national, international and leased line prices. Investments will be over SEK200 million up to 1996.

Northern Telecom experienced 11% growth in net earnings on its third quarter revenues for 1992 of $US2.02 billion, 5% up from the $US1.92 billion reported for the same quarter in 1991. Spending on R&D in the third quarter totalled $US227 million compared with $US239 million in the same quarter in 1991.

E-Plus Consortium says that turnover (not including sales of terminals) from Germany's E1 PCN network could be DM18-20 billion. One of the two consortia bidding for the licence, it says it will invest DM7.8 billion over the next 10 years and create 8,000 new jobs. There could be at least 10 million subscribers by 2000.

Analysys, a UK-based research group which has undertaken work European Commission, has backed the idea of more liberalisation in Europe. It claims the European market could grow four fold over the next 20 years if more operators are admitted. Total telecommunications sector revenues could grow from ECU90 billion in 1990 to over ECU320 billion in 2010.

Mercury Communications was scheduled to launch a national VPN in November, using cable TV networks to connect where it has no direct access to subscribers. Mercury claims there are over 80,000 Cable Telephony lines connected to its network.

British Telecom, Deutsche Bundespost Telekom, France Telecom, PTT Telecom Netherlands, SIP of Italy and Norwegian Telecom have launched EVE-2, a customer trial leading to a European digital video telephony service by mid-1993. BT wants to extend a video telephone service to North America and the Pacific Rim.

Siemens and a German university claim they have developed silicon circuits for future optical communications networks, switching traffic faster than anything available to date. The chip set works at up to 32Gbps and the decision circuit at up to 22Gbps.

Motorola reported an increase in sales of 24% to $US3.40 billion in the third quarter of 1992, up from $US2.75 billion from the same quarter in 1991. Profits were $US129 million, compared with $US93 million in the same period last year.

C&W Teams Up With Canadians

Cable & Wireless has teamed up with Canada's BCE (Bell Canada Enterprise) — putting an end to speculation about a possible tie up with US West. A C&W spokesperson said: "We are not actively seeking any further partners." Under the agreement BCE will take a 20% share holding in C&W's UK operating company Mercury Communications. C&W will in turn invest $66 million in the UK cable TV operations of BCE, taking a 12% stake rising later to 20%. But the spokesperson said: "There are no plans to float Mercury at the moment."

C&W Executive Chairman, Lord Young, said investment in BCE's cable TV interests would improve Mercury's access to UK residential customers. He said the two looked forward to working together across the world, but especially in Europe.

BCE, Canada's largest company turned over around $23 billion in the year ended December 31, 1991 and returned profits of $2.9 billion. Its subsidiaries in telecommunications services and equipment manufacture are Bell Canada, Northern Telecom and Bell Northern Research. It has an 80.4% share in East London Telecommunications and also a 30.7% stake in Videotron Holdings. (Telecom*europa*)

Hutchison Still Under Fire

Hutchison Whampoa Chairman, Li Ka-shing, has been forced to make a public statement over the telecommunications strategy of his group. Responding to renewed uncertainty from Hong Kong stockbrokers he said unequivocally that Hutchison would continue with its investment in the UK PCN network. This in spite of a declaration by Hutchison (UK) shareholder British Aerospace that it wanted to sell some or all of its stake in the company.

Li Ka-shing said: "To further clarify the position with regard to the UK operations in telecommunications, it is our firm intention to continue to support this investment. The main ongoing costs will be the continued development of the PCN network." The CT-2 and Paging networks are complete and these businesses are operational. Hutchison UK spokesperson, John Dodds said: "In Hong Kong, we are going to continue with CT-2 (telepoint), cellular and paging. In Asia, we will continue with existing businesses in Thailand, Malaysia and Australia (paging businesses). We do not intend to seek new cellular licences for the time being, other than in China." (Telecom*europa*)

Inmarsat Sets Mobile Agenda

Inmarsat hopes to reach a final decision by July 1993 on how to implement plans for its global mobile phone service, Inmarsat-P. The decision came at a meeting of the Inmarsat Council last month where it decided Inmarsat-P is 'technically feasible and is a promising business opportunity for the organisation.'

Inmarsat said final technical and market studies should be completed by May 1993. It is considering using geostationary, low earth orbiting or intermediate circular orbiting satellites. (Telecom*europa*)

Optus Joins TPC-5 Group

Forty-six international telecommunications carriers, including Australian carrier Optus Communications, have signed a construction and maintenance agreement for a new Pacific submarine optical fibre cable.

Expected to cost around $1.9 billion, the 25,000km TPC-5 cable will link the United States mainland, Hawaii, Guam and Japan and is due to be completed by 1995. AT&T is the largest partner in the project, which will be a 'self-healing' optical fibre loop able to transmit data at speeds up to 5Gbps.

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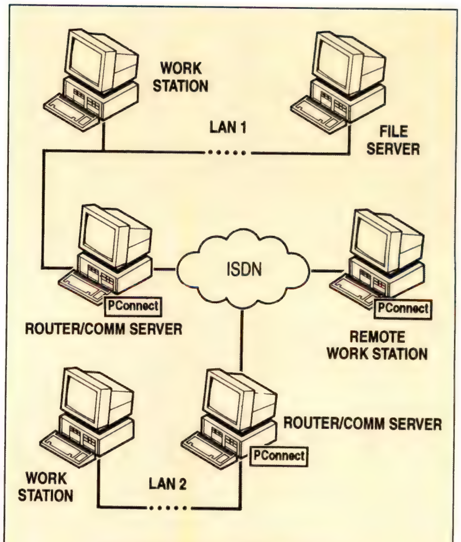

Typical LAN configuration

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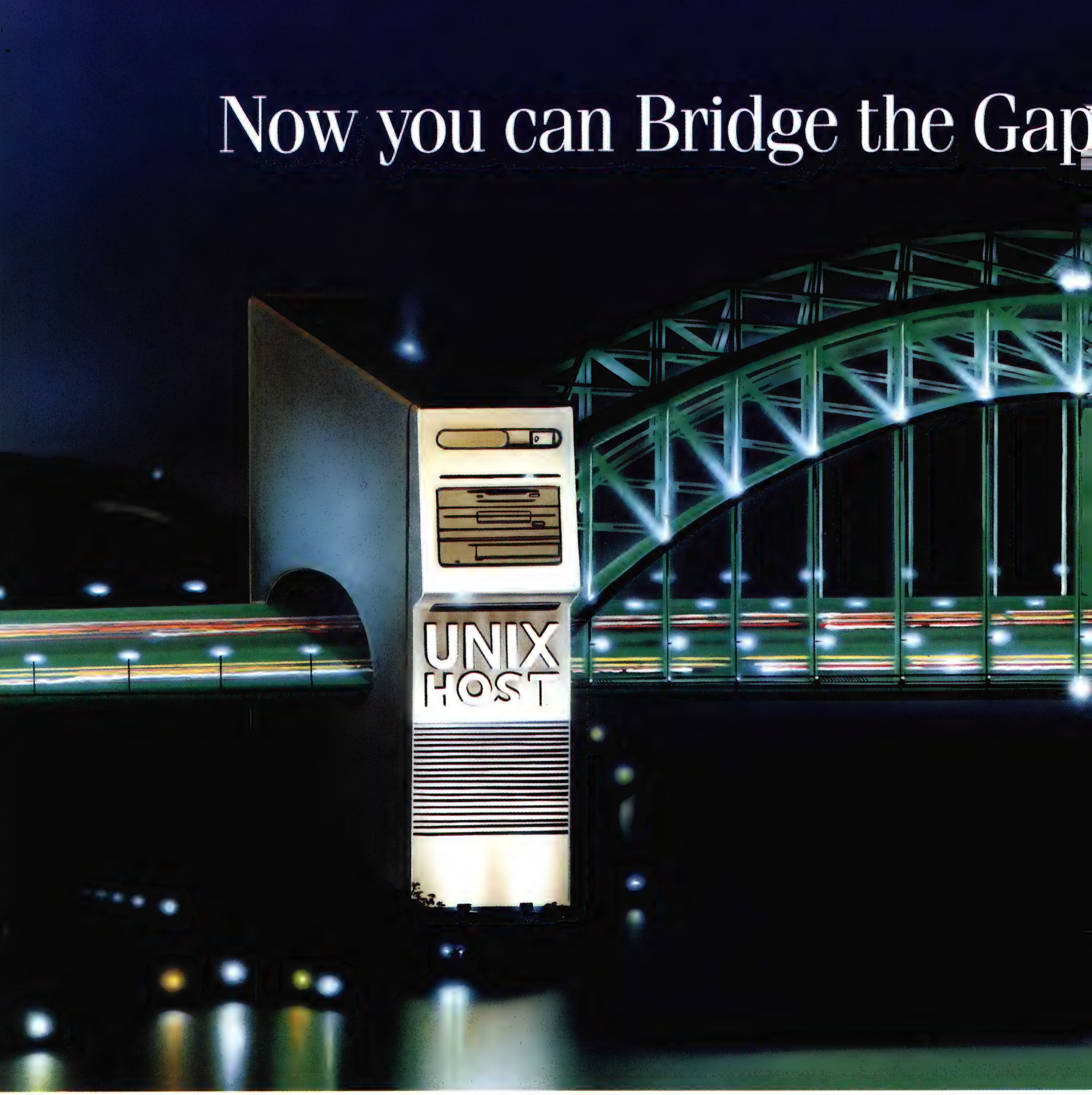

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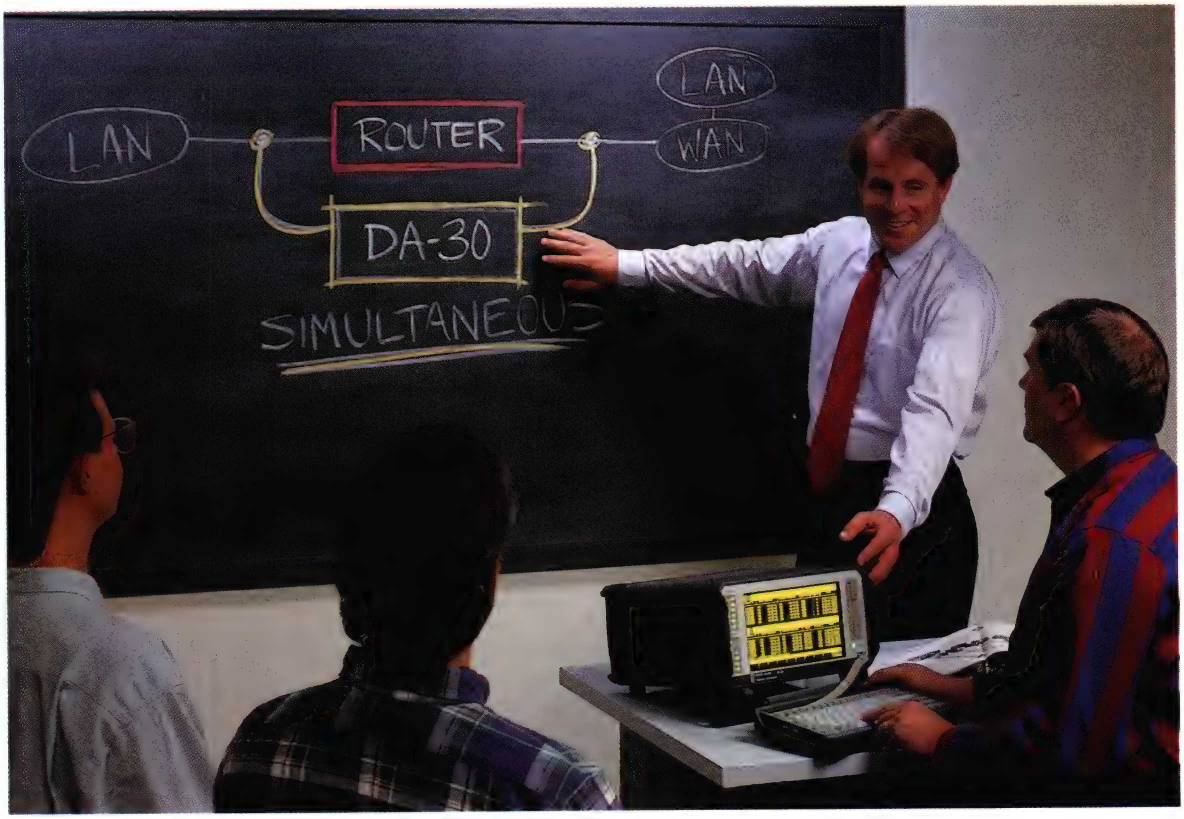

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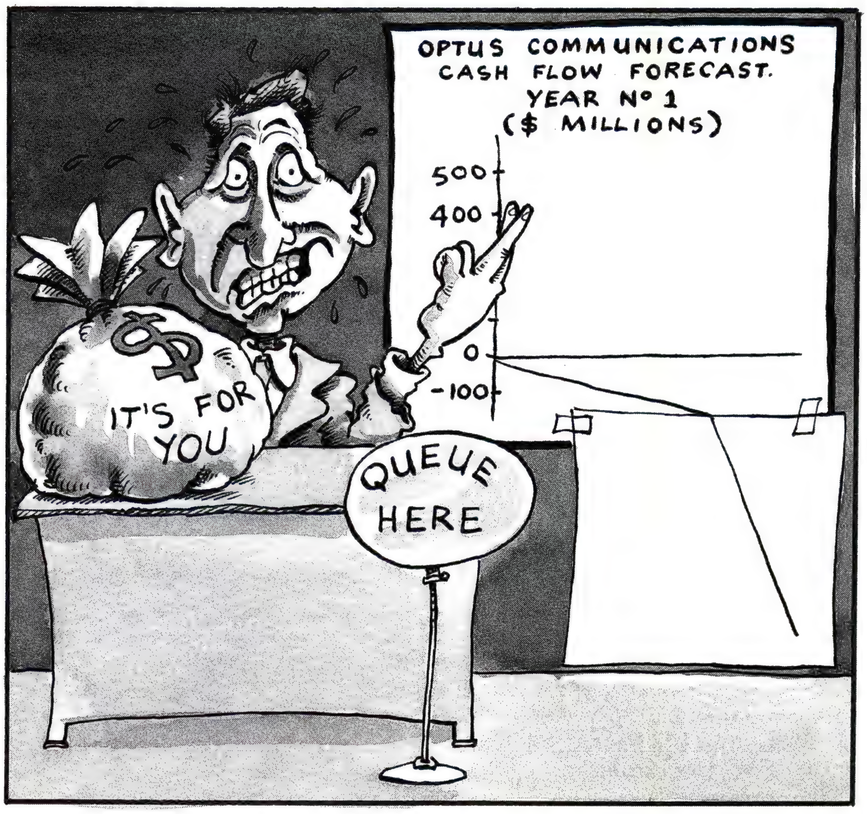
Optus Spends Up Big

In its first progress report to the Government, Optus Communications claims to have created over 1,250 new jobs.



Just as it has been saying 'It's for you' and 'Yes' in its advertising campaigns, Optus Communications has been telling the Australian Government much the same thing in its first official performance report. The Australian economy has been a winner, says the report. In Optus' first five months of operation to June 30, 1992, some $120 million in capital expenditure, of a total $270 million, was spent in this country.

The bulk of the local outlay went towards buying fibre optic cable from Olex Cables, digital switches from the NorTel-Exicom partnership, GSM radio systems from ERG and Nokia and computer hardware and software to develop the Optus network's Operational Support System (OSS).

At a time when unemployment in Australia is at an historic high, Optus says it has now created 1,250 new jobs for Australians within its own structure, and provided the catalyst for another 550 jobs among secondary industries. The report says just under 80% of the external jobs have been created by Optus strategic partner, Leighton Contractors, and the sub-contractors involved in the installation of Optus plant and cables. This employment level was likely to remain steady while the Optus network was being rolled out, according to the report.

Only 120 of the internal Optus staff jobs are being filled by expatriates from Optus shareholders, BellSouth and Cable & Wireless, recruited for their expertise in tackling newly-deregulated markets.

Closely addressing its commitments under specific clauses of the *Telecommunications Act*, and frequently referring to its undertakings during the tender process for the second licence, Optus says its roll-out is on course and on budget — except for research and development which is slightly behind target at $5.5 million. Optus' original commitment was for $100 million over five years, crudely equating to $20 million a year, or $10 million for each half year. The longer-term objective is R&D investment of $400 million by the year 2002, 85% of it to be undertaken in Australia.

According to Paddy Costanzo, Optus' Industry Development Manager, the R&D component would rise substantially over the initial five-year period as new products were developed for the coming GSM digital cellular era. Some $4.4 million in R&D funds have so far gone towards MobileSat, the updated nationwide satellite-based mobile communications network to be launched late next year. Most of the remainder has been spent on the OSS software being developed by DEC with contributions from Whitesmiths, IBM, the Computer Power Group, and Computer Sciences of Australia.

Addressing its local content obligations, the Optus report reinforces the company's on-going commitment to involving Australian companies in its operations wherever possible. While its local links largely involve Leighton, Perth-based ERG, which is providing GSM digital cellular radio systems in association with Nokia, and Exicom which is working with NorTel Australia to supply switching systems, Optus has set an agenda to bring more local companies on board.

The second carrier has also initiated a series of seminars where its procurement and planning executives will have the chance to speak with small and medium sized companies that have products and services which may be useful to Optus. The seminars have been organised with the help of the NSW and Victorian Departments of State Development and the Australian Electrical and Electronics Manufacturers Association. As well, the Optus Projects Division has begun compiling a vendor database, aimed at covering all companies which have registered an interest in doing business with the second carrier. These companies will range from carpet cleaners to earth station manufacturers.

Lavish Training Facilities

Optus' physical infrastructure now includes the Optus Centre at Miller Street in North Sydney, and its National Training and Technology Laboratory, a new state-of-the-art 700-square-metre facility at Rosebery in Sydney. The complex incorporates four learning centres and three equipment laboratories. The fully-equipped switching and transmission laboratory contains the only NorTel DMS training switch in the southern hemisphere and the only one outside the NorTel group in the world.

The laboratory fully simulates the Optus live network, and while it is dedicated to training, in the longer term it will used as a test bed for R&D involving Nokia, NorTel and Fujitsu.

"Their staff will have on-going access to the facility, and the plan is that their clients in the Pacific Region, such as public utilities, will also be able to use it," according to Joanne Buczkowska, Optus' Organisational Development Manager.

CT-2

Marketing the Test for Telepoint

CT-2, telepoint, public access cordless — call it what you will, after a disastrous start in the UK three years ago, networks using this technology are springing up around the world. In Australia, Telecom is making the running. It has taken a class licence for PACTS (public access cordless telephone service) and will shortly trial the service in Brisbane. And Hutchison, Australia's third largest paging operator, has also expressed interest in CT-2 as a service provider.

On the limited overseas experience, such as in Hong Kong, the most likely market would be existing pager users, of which Australia has about 320,000. But the market could be home users — with a kit which could also be used on the street — or it could be even be demographically defined, for example, 19-28 year-olds, or all of the above.

As Hutchison Australia's Managing Director Barry Roberts-Thomson says: "There are many markets. The trouble is, all of them have a good application, but which is the one you can have that fits?" With CT-2, the marketing begins with the actual location of the base stations (each has a range of only 100 metres). In Hong Kong, which has 800,000 pager users, the OTC joint venture Chevalier is holding its own in a difficult market. Although well behind the predicted market leader, Hutchison, it has won 7,500 customers as against 30,000. Both Hutchison and Chevalier have spent about $50-70 million on building their networks.

There are further complications for CT-2 in Australia, apart from the fundamental one of a small population spread over a large area. The Australian service would use frequencies different to the world standard (861-865Mhz as against the 864-868Mhz overseas). Hence, equipment makers are not able to benefit fully from the economies of scale, nor will operators and consumers reap the benefits of roaming. Telecom is considering implementing the service as a two-way system. With the exception of France, all systems operating at present are one-way. The two-way system requires added intelligence to locate the user. One option is for users to log-on to show they are ready to receive calls. Another is to attach a pager to the hand-set, known as the 'meet me' approach.

No wonder then that Telecom has been moving slowly on CT-2. The Brisbane trial has been imminent for six months, believed to be in part a result of problems with network equipment. The GPT-supplied base stations required a good deal of reconfiguring to ready them for the Hong Kong OTC joint venture. (The Brisbane trial will use equipment supplied by GPT and Motorola.) However, new Mobile Products Manager, Albert Sommer, denies the project is behind schedule and says he expects no difficulties with the hardware: "Whatever problems the equipment might have had . . . it's totally bedded down now. If you talked to Chevalier you'd find there are no problems."

Hutchison Australia is unlikely to be a network builder, given the company's global contraction. However, Roberts-Thomson says Hutchison is looking at CT-2 to complement its paging business, using its Hong Kong and UK experiences.

Are Cute Names the Key?

The most marked aspect of European CT-2 systems is the customer-friendly branding. Hutchison is trading under the Rabbit name, the German network is called Birdie and the Dutch, under the Greenpoint brand, are using Kermit the frog as a marketing tool.

The Rabbit phone is sold as full cordless phone for use in the home and office, priced at one-half to one-third as much as cellular. By contrast, the East Asian systems are more aligned to the business market, with brands such as Callzone and Smartfone.

The US is understood to be trialling personal communication services which offer a combination of cellular and cordless systems (e.g. cordless PABX in the office, a telepoint phone for walking around the CBD) which can be plugged into the car phone. However, frequencies are not likely to allocated for US services until at least 1993 or '94. At present there is no common frequency available across the US. Canada is going through licensing process for a two-way system now, and a start is expected next year.

Robert Clark

CT-2 Around the Globe

REGION	NO. OF CUSTOMERS	COMMENCEMENT DATE
ASIA		
Hutchison (HK)	30,000	3/92
Chevalier (HK)	7,500	4/92
Pacific Telelink (HK)	n/a	11/92
Callzone (Singapore)	22,000	1/92
Smartfone (Malaysia)	2,500	10/92
Phonepoint (Thailand)	5,000	3/92
Tian Di Tong (China/Shenzhen)	n/a	9/92
EUROPE		
Rabbit (UK) nationwide	n/a	10/92
Bi-Bop† (France)	Under Trial	3/93
Greenpoint (The Netherlands)	n/a	5/92
Telekom Finland	n/a	11/92
Birdie (Germany)	Under trial with 200 base stations	

Source: Telecom Mobile Communications Services † Two-way

"The facility can be used via satellite, so that people don't have to physically visit the site, and this should be useful to NorTel and Nokia as they expand in the Pacific."

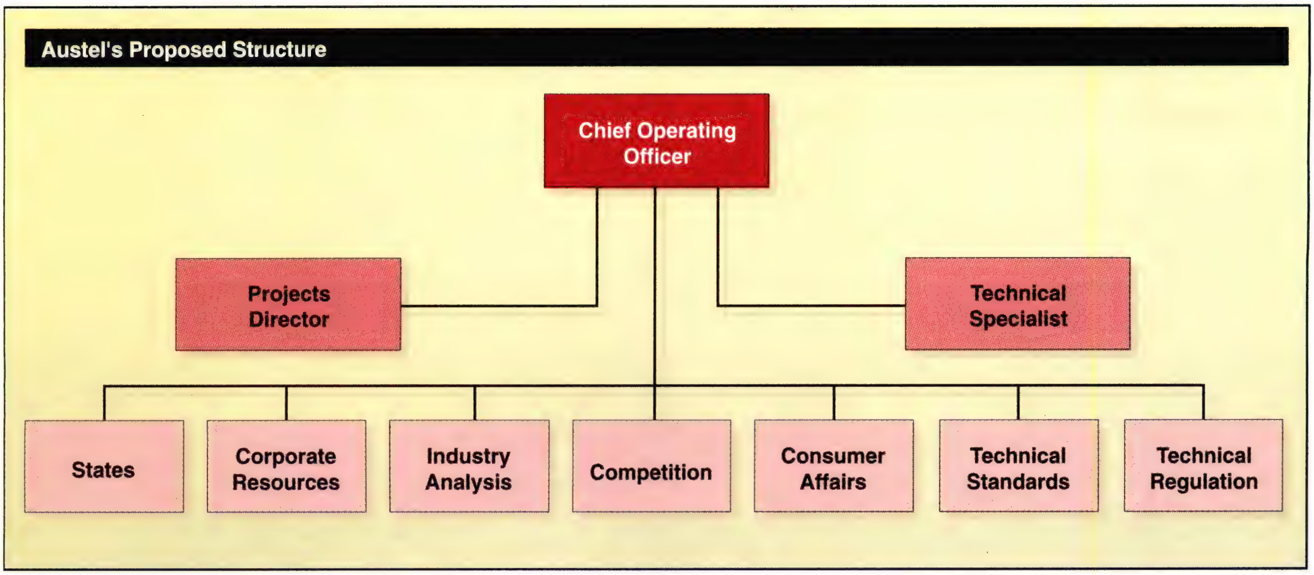
According to Assistant Secretary of the Information Industry Strategy Branch of the Department of Industry, Technology and Commerce (DITAC) who administers the Telecommunications Industry Development Authority (TIDA), John Grant, DITAC's major concern in assessing both the Optus and AOTC reports is the long-term, strategic elements of their efforts to 'grow' local industry. By this, he means technology transfers among strategic partners.

"Our job is to ensure that the local companies and locally-developed products gain access to the transnationals' distribution marketing networks overseas," he said. "When the transnationals work with Australian companies, they should be encouraging them to widen their market base. We are far less concerned about holes being dug in the ground to lay cable."

TIDA has the power to audit both carriers to check the accuracy of their reporting, but this may not occur until next year at the earliest, when TIDA would be able to audit a full year, rather than the five-month period covered by the 1992 reports. The auditing process would be the same as that applied to the Partnership for Development Program, Fixed Term Arrangements, the Pre-Qualified Offsets Scheme and the Industry Development Arrangements for Customer Premises Equipment.

Having already made a commitment to monitor its performance and licence compliance on a regular quarterly basis, Optus is clearly determined to ensure that there will not be any skeletons in the closet should TIDA decide to come knocking.

Bernard Levy is a freelance journalist based in Sydney.



Austel's Proposed Structure

Austel

Restructuring For a Leaner Future?

Telecommunications regulator, Austel, has moved into a new phase of its evolution, reorganising its internal structure and pruning back staff as it fine-tunes its role to deal with an increasingly competitive market.

With the express aim of becoming leaner and more efficient, the authority is poised to confirm the appointments of a new Chief Operating Officer (COO), Technical Specialist Advisor and a Projects Officer, and to reduce its head count from 140 to 128 by the end of this financial year. Some 116 staff will remain at headquarters in Melbourne, with three staff apiece for the Sydney, Brisbane, Perth and Adelaide offices.

Former head of Austel's Technical Standards Division, Dr Bob Horton, a founding Austel appointee and a well respected figure in the standards community, has already been appointed Technical Specialist Advisor. The new position will allow Horton to focus more closely on technical standards issues in the international and domestic arenas. The position of COO and Projects Director have been advertised in the national press, with appointments expected to be made soon, when the restructuring program will be fully implemented. The COO is understood to have been offered an all-in package of around $133,000 per year.

The COO's position will be pivotal, reporting to the Chairman and overseeing not only the roles of both the Projects Director and Technical Specialist but the stable of special-interest teams including the State offices, Corporate Resources, Industry Analysis, Competition, Consumer Affairs, Technical Standards and Technical Regulation.

Austel Chairman, Robin Davey, told *Australian Communications* the changes were the result of a shift within the telecommunications authority away from a rigidly-defined divisional structure (predominantly Technical Standards, Commercial and Secretariat) towards a more flexible, purpose-built, project-based arrangement.

This would allow teams to be selected and mobilised within Austel to carry out specific tasks, under the guidance of a Project Manager. The personnel involved would return to their specific groups once their mission was accomplished.

"Under the old structure, we found that more and more work crossed the line between the divisions," Davey said. "When we started in 1989, we had a fairly narrow mandate, but this expanded significantly in 1990/91 with the introduction of the new *Telecommunications Act*. Whereas we were initially operating under 180 sections of the old Act, we were now operating under 410. Obviously, this meant we had to rearrange ourselves and I personally made the decision, given that we were three years old, to bring in consultants to review our operations and to make recommendations on how we could improve them."

Melbourne-based Madden Consulting Group sent in two full-time, on-site consultants for the main work, with the help of other outside specialists running focus groups within the authority over an eight week period. Lengthy discussions were held with senior Austel staff. Advice was also sought externally from the authority's major client grouping, ATUG, the AEIA, AIIA, the Communications Law Centre, the Consumers' Telecommunications Network, officials at the Department of Transport and Communications and CIRCIT.

On the possibility of a more rigourous assessment of Austel's role and a further reduction of staff should the Coalition win government next year, Davey said: "I would hope that what we're doing now makes us a more lean and efficient organisation. We're not into empire-building and I'm more than prepared to respond to the government of the day. In my opinion, we already have a reasonably efficient machine in place."

Under proposals put forward by Shadow Communications Minister Warwick Smith, Austel's role would be more tightly focused on the detailed implementation of government policy, the resolution of disputes over interpretations of the *Telecommunications Act*, the establishment of standards in conjunction with Standards Australia (which could eventually take over this role altogether), administering the national numbering plan and ensuring the full portability of telephone numbers between carriers by controlling the databases and acting as a consumer affairs advocate, along with the Trade Practices Commission and the new Telecommunications Industry Ombudsman, whose future existence Smith has brought into question.

Asked about Austel's projected staff level of 128 compared with a similar number running the UK regulator Oftel, Davey insisted that Austel had a wider mandate, and Oftel was not involved in many of the issues covered by Austel.

Criticism of Austel's structure has come from ATUG's Issues Manager Alan Robertson, who said he found it strange that Robin Davey was now effectively the Chairman and Chief Executive Officer. "It's a strange management arrangement and we don't believe the Austel Board is a board in the true sense of the word," he said.

"Robin Davey is only answerable to the Minister and in reality people like (Austel Board Members) Johanna Plante and Alex Arena are effectively his subordinates. The board should be more representative and it should play a more supervisory role." But ATUG had "no beef" with Austel, Robertson said, and the authority seemed "genuinely keen not to become a large bureaucracy."

Bernard Levy is a freelance journalist based in Sydney.

AIIA Annual Report

At Least Exports Are Up

The Australian Information Industry Association (AIIA) has committed itself to paying closer attention to the needs of the telecommunications sector — and to exports — in its 1991-92 annual report which reveals these two areas experienced strong growth, against the overall downward trend.

The switch in focus is among the most significant policy initiatives to emerge from the report, which paints a brutally honest picture of the state of the domestic IT industry, with revenues generally stagnant, employment down and research and development investment on the wane.

While computer hardware sales plunged an alarming 30%-plus, total revenues among the AIIA's 245-odd members grew by just 0.3%, remaining at around $18 billion. By contrast, telecommunications sector revenues maintained their strong growth, contributing some $12.5 billion towards the $18 billion total, up from around $11.7 billion in 1990-91. Exports, meanwhile, increased 38% in 1991-92 to $1.16 billion thanks to a hefty boost from hardware, services and support, with software exports remaining static. Imports by almost 25% from around $2.75 billion to about $2.1 billion.

While overall capital investment in the IT industry rose just 2.8% to just over $3.5 billion, research and development funding fell by 6% to $274 million, in what the AIIA said reflected 'difficult market conditions.' On a more optimistic note, the AIIA's projected total for capital investment and R&D in 1992-93 is around $3.85 billion.

On the employment front, the total headcount among AIIA members dropped by 5% to 101,716, the report said. But if the telecommunications services sector is removed from the calculations, the picture worsens with a total loss of 2,800 jobs among AIIA members for a fall of over 10%.

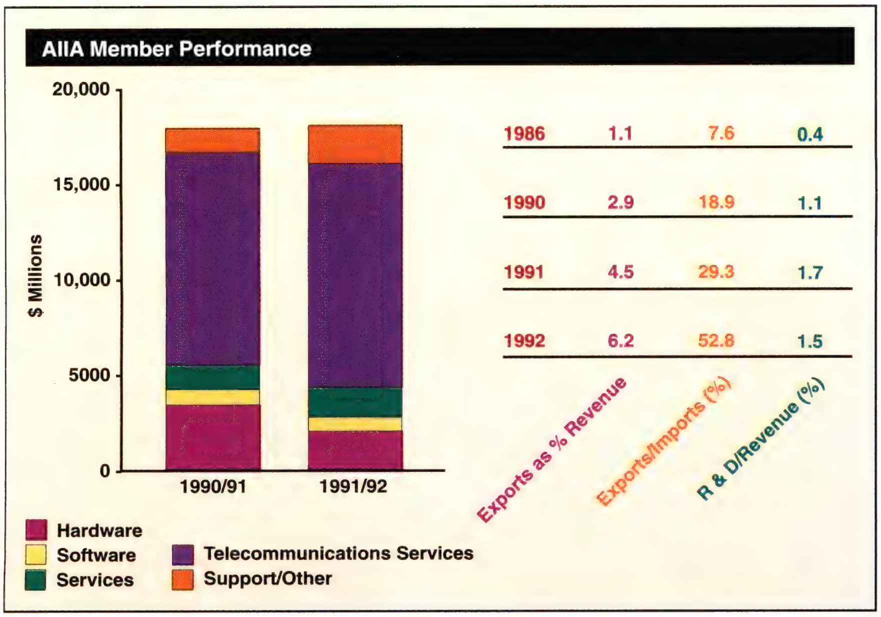
After a year of intensive reassessment largely brought about by the recessed economy, the AIIA has also made a commitment to improving the quality of its annual survey. It will now more rigorously verify the figures from its members against publicly-available data. To a large degree this is aimed at addressing questions about the accuracy and relevance of the AIIA figures, given that members provide the information confidentially with guarantees that completed questionnaires will be shredded once the information is collated and aggregated, and that the composition of the AIIA membership itself changes from year-to-year.

But How Much is Re-Exported?

The Department of Industry, Technology and Commerce (DITAC), has described the report as 'encouraging.' DITAC's Acting Director, Government Purchasing Section in the Information Industries Branch, Ian McAlister, said the AIIA figures "reflect the important contribution of the Australian IT industry to Australia's balance of trade."

"The figures represent a large proportion of the Australian IT industry, and they support and are in line with the Government's trade figures for the industry," he said.

"The AIIA survey forms an important element of the Department's collection of IT industry statistics and complements figures produced by the Australian Bureau of Statistics, International Data Corporation and the Department's own internal sources." These sources are understood to include the Partnership for Development Program, among others, and the DITAC total for IT exports is known to be closer to $1.3-1.4 billion than the AIIA's $1.16 billion.



	Exports as % Revenue	Exports/Imports (%)	R & D/Revenue (%)
1986	1.1	7.6	0.4
1990	2.9	18.9	1.1
1991	4.5	29.3	1.7
1992	6.2	52.8	1.5

Issues raised in other parts of DITAC, the Department of Trade and the Department of Transport and Communications included the question of re-exports, in which imported product is re-boxed with very little value-added component, then shipped on to other countries. The ABS is understood to be planning to look more closely at this issue.

"While we are all being encouraged to be nice to the AIIA, you cannot ignore the fact that a lot of its members are local branches of multinationals, and the kind of information they give to the annual survey can depend very much on what sort of picture they want to paint," one DITAC source said. "For example, some companies claim all income earned offshore as exports; others — for various reasons — will claim only a small percentage when the department knows something quite different."

"The AIIA started with a predominance of multinationals like the IBMs and so on, and even though this has now gradually changed, you still end up with conflicting interests within the group. Take the example of the Prices Surveillance Authority ruling that software is too expensive in Australia."

The AIIA's new focus on telecommunications will to some degree be at the expense of the computer vendors which enjoyed phenomenal growth rates in the decades leading up to the 1990s, but are now being forced to accept a 'mature industry' status. While reviewing the entire telecommunications sector to ensure that the needs of its members are being met, the AIIA will define objectives in areas such as the regulatory environment, industry development and technical standards, as well as determining the sort of telecommunications environment its members will need over the next five years.

The AIIA also says that it will report in more detail on the IT industry's performance in the critical areas of exports and R&D. Exports as a percentage of company revenues will become a regular feature of future annual surveys, as will exports as a percentage of imports, and R&D as a percentage of company revenue.

The AIIA's stronger focus on export enhancement and facilitation for its members has been strengthened in the past year by the appointment of an Export Marketing Manager, Chris Begley, on secondment from Austrade, who has provided AIIA members with advice and information on export opportunities.

Begley's contribution to the export figures in the AIIA's annual report is acknowledged by DITAC in a written statement: "The more rigorous approach to data collection this year perhaps reflects the input of the Austrade Export Marketing Manager outposted to the AIIA and the stewardship of the organisation by (Deputy Executive Director) Mr Rob Durie."

Continued on page 30

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AARNet

Getting a Slice of the $13 Million Pie

After months of wrangling and confusion, AOTC may emerge as the big winner in the upgrading of the Australian Academic Research Network (AARNet) and the funding of more research data networking, expected to be formally announced around the middle of this month. But the prize may turn out to be somewhat different in shape and scope to the one the former monopolist first had in mind. And the $13 million in federal funding that will fuel these developments may very likely be shared around among more establishments in the research community than AOTC first envisaged. AOTC may well form the backbone, but it will very probably have more appendages than it feels are necessary for the task in hand.

When the $13 million to upgrade AARNet and to stimulate research data networking was first mooted in the August 1992 Budget, AOTC's immediate response, according to the best informed sources, was: 'We'll take care of that.' Not so surprising given the corporation's undeniable expertise and muscle and the apparent lack of anything like a viable competitor in the private data networking arena. Optus Communications was invited to make an offer but bowed out, citing the pressures of early network roll out.

But AOTC's somewhat proprietary attitude struck the wrong chord with the men and women who run the nation's universities and academic research institutions — specifically, the membership of the Australian Vice Chancellor's Committee (AVCC).

Their protestations, upheld by the former Chief Scientist and Chairman of the Government's Cooperative Research Centre (CRC) Committee, Professor Ralph Slatyer, have now forced AOTC to modify its proposals to more closely embrace the original research aims of the funding and to involve a range of CRCs in the research data network program under the acronym, RDN-CRC. Rather than forming a single, new RDN-CRC, Professor Slatyer has ordered that the project be spread across a range of existing CRCs with an IT focus.

One criticism of the original RNC-CRC concept was that while CRCs are research-orientated, AARNet itself is a service facility. It would therefore be extremely difficult to simultaneously experiment with improvements to AARNet, while AARNet itself was still required to provide a reliable transmission service.

Having keenly promoted a Fastpac solution since the very earliest days of discussion of an AARNet upgrade in Adelaide some three years ago — Fastpac was at that stage future technology — AOTC answered the $13 million Budget announcement with a proposal for an experimental broadband network valued at up to $20 million, with the additional inducements of support and staff worth another $1 million a year. A handful of CRCs, at Wollongong University, Curtin in WA and others, stood to ride the AOTC proposal.

But somewhere, according to the nominal controllers of AARNet, the AVCC, AOTC lost the plot, or rather, substituted its own. Despite lengthy negotiations, AOTC and its proposal partners, IBM, CSIRO and the Australian Computing and Communications Institute, failed to reach agreement with the university establishment, triggering tension within the academic community involving the AVCC and the hands-on managers of AARNet. The dust may take some time to settle, according to university network sources.

Paying the Bills

One of the biggest problems for the AVCC has been the fear of usage charges under a Fastpac solution; becoming locked into a billing system beyond its control is not a prospect the AVCC relishes. This in turn has led to claims that the AVCC has become 'possessive' about AARNet, insisting on maintaining the network's focus on academic institutions and consequently hindering AARNet's expansion and originally intended commercial exploitation.

Under the present AARNet funding structure, universities and academic institutions pay for AARNet on the basis of their size — for example, the University of Sydney pays a flat $100,000 per year while smaller universities pay around $20,000.

"Many of the Vice Chancellors feared they would never be able to estimate the costs of their AARNet usage; there would be uncertainty about the costs on an annual basis and there would be no control of those costs," said AARNet's University of Sydney Coordinator, David Phipps.

In the end, the AVCC, chaired by the University of Sydney Vice Chancellor, Professor Don McNicol, prevailed and AOTC was forced to soften and sweeten its approach under the so-called 'disaggregated' approach to the RDN-CRC ordered by Professor Slatyer.

In essence, AOTC and its partners were asked to submit their RDN-CRC proposals separately, keeping the intended research aims of the $13 million in mind. This has allowed other groups, such as the Narrowband Working Group, led by Albert Langer and the Australian National University's Dr Roger Clarke, a window of opportunity for involvement in the AARNet upgrade.

New outline proposals were requested by November 9, with full details by November 23. An official announcement on the RDN-CRC is expected by December 14, after a crucial meeting of the CRC Committee, which will by then have received advice from the Government's Physical Sciences

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The Broadband Future

Do We Have a DVC Future?

Remember 1976? Colour television had just started in Australia, there was no Group III fax, no domestic video recorders, the idea of a domestic satellite had not even been mooted and there were no personal computers. And yet it seems like only yesterday.

That brief reminiscence is contained in a new report on digital video communications (DVC) to drive home its central arguments. The report (which has been published by DITAC and exhaustively titled *Public Policy Issues and Service Industries Opportunities for Australia in Digital Video Communications*) contends:

- That the changes which electronic technology will bring to society over the next 15 years will be equally as great as those of the past 15, perhaps even greater;
- That digital video communications will be at the heart of many of these innovations; and
- That Australia must act now if it wants to be more than a passive consumer of the products of foreign inventiveness and foreign industry.

The report is not advocating that Australia will develop and manufacture the mass market technologies of the digital video era, but it does believe that Australia has much to gain from being a leader not a follower.

'Because of Australia's small market relative to others in the world, it is not likely that Australia will play a leading role in the manufacture of equipment (but) by finding niche markets and other opportunities now, Australia can lead rather than follow . . . it can identify and exploit manufacturing niches, and look for greater opportunities in software and service industries applications.'

The emphasis is very much on the *now*. 'Australia has only a few more years in which to plan for the introduction and development of DVC,' the report says. Urgent action, it pleads, must be taken now. But just what are the DVC opportunities, what fast action is needed, and what are the implications of the report for the telecommunications industry in Australia?

The report identifies 24 applications of DVC which would be familiar to most people involved in the telecommunications industry. The DVC list includes teleshopping, telecommuting, video art and of course HDTV. With the exception of television and video games, all according to the report involve the telecommunications industry (but who's to say video games can't be played interactively over a communications link, or downloaded from a central database?).

The report is short on identifying specific niches and opportunities for Australian industry, but has plenty to say about the sorts of actions that need to be taken to create the right environment to get things moving.

Achievement of the report's vision will be a long, uphill battle, and with time supposedly already short the report's timetable is already about a year behind schedule: Several of its recommendations were for actions to be taken six months before the report was eventually published.

The report is in part, a victim of its own vision. Paradoxically, the more comprehensive the plan and the more far-sighted the vision, the harder it is to make progress. One Government official told the author that some of the report's key proposals would require so many initiatives from so many different government departments that it would be very difficult to make anything happen at all because no one person or department had sufficient power to take the lead. Indeed, the large number of players involved in the preparation of the report was a contributing factor to the delay in its publication. They included DITAC, Telecom, the Australian Coalition of Service Industries and the Queensland University of Technology.

One of the first recommendations of the report was that it be given a high profile launch, and it was at one point thought that the Minister for Industry, Technology and Commerce, John Button, would do the honours, but apparently the sponsors could not agree with some of the report's recommendations and it came out not with a bang, but a whimper.

One positive result has been the formation of the Australian Harmonisation Group: A committee comprising representatives from a very broad spectrum of Australian organisations on which digital video communications could have an impact: Users, manufacturers, carriers and government.

Rubbing shoulders with Telecom are Sony, the advertising agency Chiat/Day/Mojo, management consultants McKinsey and Co as well as News Ltd, Microsoft and many more.

The committee met for the first time in October with the aim of developing common standards for digital video communications across the whole gamut of industries and applications.

Another of the reports major recommendations seems bound to founder on its scope and cost in these recessionary times. It called on the Commonwealth Government or an industry organisation to sponsor a national road show. It would travel the length and breadth of the country for a year, exhibiting the latest technology and convening briefings for senior executives on the technology and its possibilities.

The cost has been put in the millions, but the report makes no bones about its belief that such extravagance is needed: 'A visible and significant action is necessary if Australia is to be jolted from its relatively lethargic state and internationally lagging position into getting a reasonable share of future international trade in services.'

One of the principal authors of the report, Les Free, now Adjunct Professor at the Communications Centre of the Queensland University of Technology, described it as a vision for the future of Australia's communications industry the like of which has not been seen since Aussat was first mooted a decade ago.

Free, of course was also one of the main movers and shakers behind Aussat and says that since that long and sorry saga he has learned a few tricks about pushing visions through the trials and tribulations of bureaucracies and vested interests. Only time will tell . . .

Stuart Corner is the Editor of Exchange.

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and Engineering Panel and other experts, on the third and final round of proposals under the two-year-old CRC program. But apart from some cosmetic nips and tucks, little appears to have changed since Professor Slatyer's edict. AOTC has a direct interest in at least eight of the dozen-odd new proposals recently submitted to the Office of the Chief Scientist.

Chief among the proposals is Wollongong University's planned CRC for global intelligent advanced network telecommunications (GIANTS), a research program to facilitate the upgrade of AARNet to a fully integrated broadband communications network. Another from the Edith Cowan University is for a broadband integrated service pilot network, to be associated with the proposed broadband telecommunications and networking CRC at Curtin University in Western Australia.

Both the University of Sydney and Melbourne University have applied for funds to research the technology and architectures for high speed digital photonic networks. A separate University of Melbourne proposal is for additional research in the area of multimedia network management and control.

Monash University has weighed in with a research program in video applications and network performance, while the University of Queensland has its hand up for three research programs covering resource discovery, distributed multimedia applications and the provision of cooperative working services to research networks.

The ANU, meanwhile, wants funding for advanced computational systems, distributed high-performance computing and distributed interactive multimedia services.

According to AOTC's General Manager, Network Strategy, Peter Gerrand: "We've responded to the call for new proposals on

Continued on page 30

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Research and Development

Shake-Up For Telecom Research

Telecom Research Laboratories (TRL), one of Australia's pre-eminent high tech research facilities, is set for probably the biggest shake-up in its history. The incumbent Head of Research, Harry Wragge, a veteran engineer with over 40 years experience at the Labs and the latest in a long line of distinguished scientist/engineers to head-up Telecom's research efforts, is to be replaced with a dyed-in-the-wool businessman: Ray Liggett, currently head of the Corporate and Government Business Unit and the first non-technical specialist to head the organisation. Wragge will fill the new post of Chief Technical Advisor, reporting direct to AOTC CEO, Frank Blount.

According to the Telecom press release announcing the appointment, Liggett will: "Oversee research activity with the emphasis on its commercial application within product and service development to meet the needs of Telecom's business units and their customers." At first glance this emphasis seems to be already in place. Around 85% of the Lab's annual budget is funded by customer business units of the organisation on a contract basis. Only 15% is allocated at the Head of Research's discretion for 'blue sky' projects. Explaining the decision to appoint Liggett, Blount told the author that the move was intended to put research more closely in touch with commercial realities.

It does however raise the question of exactly how much commitment and involvement in research should a carrier make in a competitive environment. British Telecom was widely criticised following privatisation for winding down the pure research component of its research activity.

A report last year from the Allen Consulting Group (*Developing Industry Strategies in Australia*), commissioned by DITAC, concluded that 'Telecom/OTC appears to be investing in R&D below the levels of major overseas telcos.' However, it also revealed that two of the major contenders for the second licence, Hutchison and Cable & Wireless spent virtually nothing on R&D, choosing instead to buy the best technology available and leave the R&D to their suppliers.

An executive of one of those suppliers told the author recently that having AOTC as a client was very different to having an RBOC as a client: RBOCs, he said, had little high level technical expertise and tended to rely heavily on suppliers to help them define high level very technically-oriented customer services. Thus, he spent much of his time closely involved at the marketing and customer level.

In Australia, Telecom has that expertise and tends to buy the technology and do things itself. His role here was much narrower, being more oriented towards meeting the carrier's technical support needs. If you raise with anyone at the Labs as why Telecom should be involved in research, instead of leaving it to the suppliers, the first thing they will tell you is that a high level of research expertise is needed to 'keep them honest.'

There's a strong belief that the forces of competition in the supply industry are not sufficient to ensure innovations are introduced as fast as technically possible, or as fast as the carrier would like. Obviously no manufacturer wants to scrap a product line too soon, it wants to get as much return as possible on the sunk product development costs which are a large portion of the cost of any high technology product. Pressure from competitors alone, it seems, is not sufficient to stop them dragging their feet.

This year's AOTC annual report notes that 'Success in a competitive environment will place a premium on advanced research.' Yes, but does one have to do the research oneself, or can one simply buy the fruits of it to ensure that success? This will surely be a question likely to exercise the mind of the new TRL Chief to a considerable extent as he tries to decide which areas of research it will be most important for Telecom to focus on as competition puts pressures on margins and as the corporate policy of concentrating resources onto Telecom's core business is is implemented.

Stuart Corner is the Editor of Exchange.

Global Networks

Infonet Looks For Strategic Fit

It may have been a sign of things to come when the head of the US Federal Reserve Bank, Alan Greenspan, voiced his concern recently that the global finance markets move too fast for regulators. His comments, in the wake of the run on the UK pound, have been widely read as indicating a trend towards re-regulation of the financial sector and has implications for transnational data flows in general. But according to Infonet Chairman and President, Jose Collazo, Infonet is in the centre of the global data industry, and regulation is impossible.

"You can't control data flows. Money market operations go 24 hours a day. When London closes, New York opens, and when New York closes, Tokyo and Sydney open, and so on. It's difficult for London, or anyone else, to control it." Noting that individual banks made millions of dollars by speculating on sterling two months ago.

Collazo was in Australia recently for a board meeting. The Australian angle for Infonet is Telecom's 5.38% holding, giving it a minor stake alongside other telcos like MCI (25%) and France Telecom and Deutsche Bundespost Telekom (with 16.7% each). Operationally, Telecom doesn't do much for Infonet except provide local tails. Indeed, Australian Manager, Kevin Ziebell emphasises that it operates at arm's length from Telecom.

So while Collazo talks up the strategic advantages Infonet provides, it is hard to see how it fits into the company's present plans to become a major regional player. Collazo agrees Infonet does not figure highly in AOTC's strategies. He and Ziebell said senior AOTC executives, 'especially on the OTC side,' needed to be 'educated' about Infonet's potential. On the OTC side Infonet in fact has a rival, SprintNet. OTC announced last December, just a month before the merger with Telecom, that it would become the Australian partner of Sprint International in its global data network services operation.

Privately, insiders expect the two groups will merge by the middle of the decade. Meanwhile, they are competitors, at arm's length, cooperating with Telecom only minimally. This may be because Telecom regards Infonet as a possible rival. On paper at least, Infonet seems at risk from telcos as the industry globalises. Collazo firmly denies this: "Our strategy is to not to put ourselves in a position of conflict with telcos, because in many cases they are our partners."

Notwithstanding that, he sees AT&T and BT as his main rivals. AT&T is still establishing its international infrastructure, while BT's Syncordia project has not yet taken off, their size and strength make them the most likely competitors. "Not every telco is going to be a global player. Some will be successful as global players, like AT&T and BT, or regional, like some European companies."

Infonet claims carriers with traditional bilateral telco relationships have no experience of managing a global business, and what experience they do have is in voice, not value-added. Infonet serves more than 10,000 customers around the world with a recorded growth at 25% in recent years, especially in Western Europe (it does no business in Eastern Europe) and Asia.

Collazo said, "Businesses will demand truly global services. No matter where they are, they want to get the same service they get in Sydney. So this area of easily providing a high speed data communication service is what the market is asking for." Infonet customer, the Swiss giant Nestle uses Infonet's Notice system to integrate its 40 different e-mail systems in more than 80 countries. Infonet's Infolan product, launched in June 1991, was the first to offer global LAN-WAN interconnect, with speeds of up to E1/T1 out of nearly 20 nodes.

Robert Clark

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AIIA from page 22

Begley has most recently been involved in promoting the Asian and Oceanic Computer Industry Organisation (ASOCIO) conference in Bangkok from December 7-9. He has also been advising on the export elements of the annual report and liaising with the former Chairman of the AIIA's special interest group on exports, Len Rust of IDC and his successor, Pat Gallagher of The Computer Group.

Recognising the wealth of knowledge on exports Rust has gained over the years, Gallagher, who says he is "passionate about exports," has been given an assurance by Rust that he will continue to contribute to the AIIA's export enhancements effort at a committee level.

Gallagher is among five new AIIA Directors, including the AOTC's Frank Blount, John Hendry from BHA Computer, Norman McCann from Ferntree and John Price from JSP Associates.

Gallagher will also sit as a Director on the Executive Committee of the AIIA Board, chaired by CSA's Peter Rehn, with Unisys' Dick Simpson as Deputy Chairman, Fujitsu's Neville Roach as Treasurer and Aspect Computing's Lyndsey Cattermole and Techway's Dick Webb as Directors. The other non-Executive Committee Directors are Roger Allen from Computer Power and Brian Finn from IBM Australia.

Peter Upton, formerly with public relations group Burson Marsteller, this month takes over the role of AIIA Executive Director, which was temporarily filled by Rob Durie after the departure of Bob Mounic, now with US software giant Oracle after 14 years with the AIIA.

Bernard Levy is a freelance journalist based in Sydney.

AARNet from page 26

the basis that unless Telecom can provide an experimental broadband network — this would operate at even higher speeds than Fastpac — then the RDN-CRC simply could not happen."

"AARNet would be able to resell Fastpac and we are encouraging them to do that. What we are proposing is a strategic partnership because QPSX technology can be value-added by addressing the needs of the end-users."

While AARNet usage charges remain a contentious issue, AOTC has an answer. According to Gerrand, the Fastpac product team has been talking with AARNet Manager, Geoff Huston, and assessing the network's eligibility for a Whole of Business (WHOB) discount under which a fixed charge could be set, up to a certain ceiling of traffic. "Telecom recognises that private network resellers are important customers in their own right and we have put in place a new account team arrangement to give AARNet much more individually-focused customer service," Gerrand said.

"Don't forget that if we offer AARNet a discount, we are legally obliged to offer the same tariff structure to any other user with the same volume of traffic. Our understanding of the AVCC assessment is that Fastpac would be more economical over an exponential growth period of between four and five years."

While Geoff Huston maintains close links to the AVCC, he has insisted on keeping an open mind on all the available AARNet options and regards Fastpac as a good option for handling high volumes of traffic. Down the track, he says AARNet could examine what Optus and others have to offer.

Naturally enough, AOTC's main interest is to sell more bandwidth. Any decision the AVCC makes about the Fastpac solution will be based on tariffs and the character of traffic bursts and volumes.

"Clearly, any high speed public switched service such as Fastpac must have intrinsic advantages over chopping and dicing the bearer service which is happening now. Our job is to interconnect routers. Fastpac is a whole-of-transmission technology which can help us do that."

The stakes for AOTC and others are huge, given the many thousands of largely academic and research-orientated users now linked to AARNet in Australia, the US, Europe and other parts of the globe. The grander prize is the enormous potential for expanding the user base among commercial organisations with related research interests.

AOTC believes that AARNet has the potential to become the largest private data network in the country — a long way from the original days of ACSnet, based on a Norwegian model, Nordunet, which itself was modelled on the original US research institution network, the Internet.

The lobbying and strategic positioning over AARNet and the RDN-CRC has continued relentlessly over the past month, as the Government's science-related committees and panels have sought to reach consensus on a set of proposals that will meet with the ultimate approval of the Minister for Science and Technology, Ross Free.

With little certainty about the future of the Labour Government at the next election, the risk for all involved in the RDN-CRC project is that, at best, it would be seriously delayed, or at worst, the funds would be lost in a change of government.

Most involved are busy holding their breath for an early decision.

Bernard Levy is a freelance journalist based in Sydney.

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Coming Soon: The LAN Superbox

Devices that include hubs, bridges, routers, analysers, SNMP agents and high speed switches promise to bring order to premises LANs.

Like old houses, most building or campus LANs are piecemeal creations assembled more by feel than design. A typical premises LAN may have started out as a collection of small departmental segments — some Ethernet, some Arcnet, some Token Ring — in which PCs were linked by passive hubs. As the LANs grew, organisations added hubs, analysers, and management systems as needed; bridges and smart hubs were thrown into the mix to link interdepartmental hubs and to connect to segments in other departments. The internetworking era brought routers and their wide area links to other LANs. At every stage in this building process, the chances were good that software and equipment came from one or more new vendors.

The build-as-you-go approach to corporate LANs has exacted a heavy toll in terms of reliability. According to a 1990 survey by market researcher Infonetics Research, the average LAN is out of commission 6% of the time. That's far too much downtime.

A solution to the premises LAN reliability gap is now emerging. Vendors of LAN equipment and software are banding together to bring all the components needed for a building or campus LAN into a single device: The LAN superbox. Early versions comprising hub, bridge, router, analyser, and management functions are now hitting the market — although fully integrated devices are probably another three years away. Eventually, these devices will be equipped to handle gigabit-speed asynchronous transfer mode (ATM) switching, bringing the massive bandwidth needed for emerging applications like multimedia and imaging.

Although most LAN superboxes will be the result of the joint efforts of a number of vendors, the platform itself will be provided by a single supplier. Hub makers like Cabletron Systems and Ungermann-Bass have taken the early initiative in developing superboxes, but the door is open for systems giants like IBM and DEC to join the market as well. The fact that one vendor will integrate and support all the components should make premises LANs more reliable.

Inside the Superbox

Along with improving reliability, the superbox significantly streamlines the LAN's physical presence (see Figure 1). Smart hub modules in the superbox connect PCs, servers, and workstations in logical LAN segments. Each logical segment is connected to a logical backbone LAN by a built-in bridge. The backbone LAN is connected to router modules that provide WAN links to other networks. In the LAN superbox, all these elements are interconnected by a high speed ATM switch. In initial models, ATM cell switching will connect bridges and routers; future versions also will link individual LAN devices, providing each device with cell relay bandwidth ranging from 150Mbps to gigabit speeds. Superboxes can link at the ATM layer to form high speed campus-wide LANs.

For management, SNMP agents monitor all the functions of the superbox. LAN and WAN analyser software keeps track of all traffic passing through the superbox. And remember, all these components and software functions are housed in a single hardware platform that is serviced and maintained by a single vendor. Adding redundant components becomes much more affordable: For instance, instead of having to add a second power supply to every standalone hub or router in a LAN, only one redundant component is needed in the superbox.

The superbox takes some of the heat off vendors that up to now have had to grapple with product issues beyond their core range of expertise. Specialisation is a clear benefit for vendors and users alike.

A Gradual Change

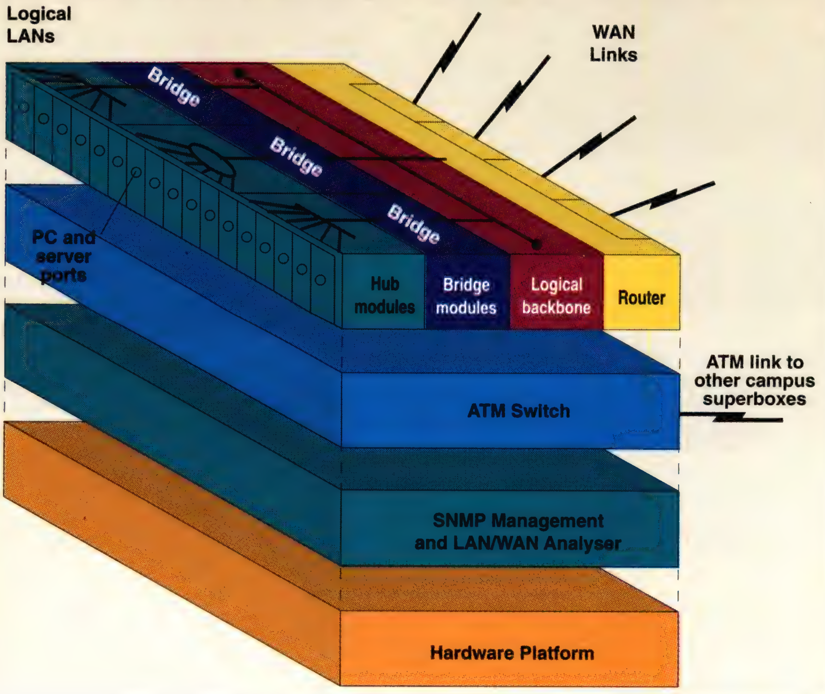
The LAN superbox is the culmination of efforts by LAN suppliers to bring premises networks under control. Wiring hubs were the first equipment type aimed at minimising LAN chaos. In the early days of LANs, Ethernet segments snaked through buildings. Adding new stations to a segment required cable taps that had to be spaced correctly; a single cable fault could bring the entire LAN down. Wiring hubs brought the segment into a central location, creating what has come to be known as the LAN-in-a-box.

Wiring hubs also addressed two other problems that often plagued early premises LANs: The use of different media types and the lack of an overall management system. The modular design of wiring hubs enabled users to install wiring cards accommodating different types of media.

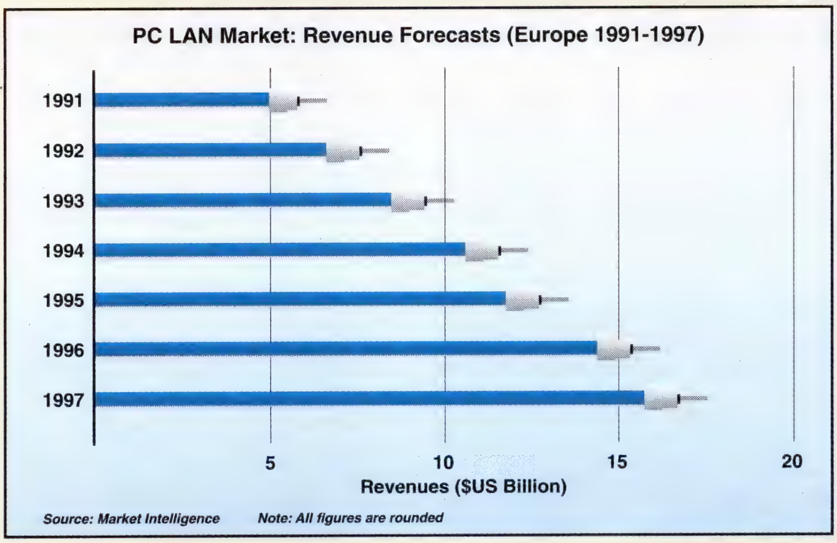
The need to manage all the components in the LAN gave rise to the second-genera-

Figure 1: Introducing the LAN Superbox

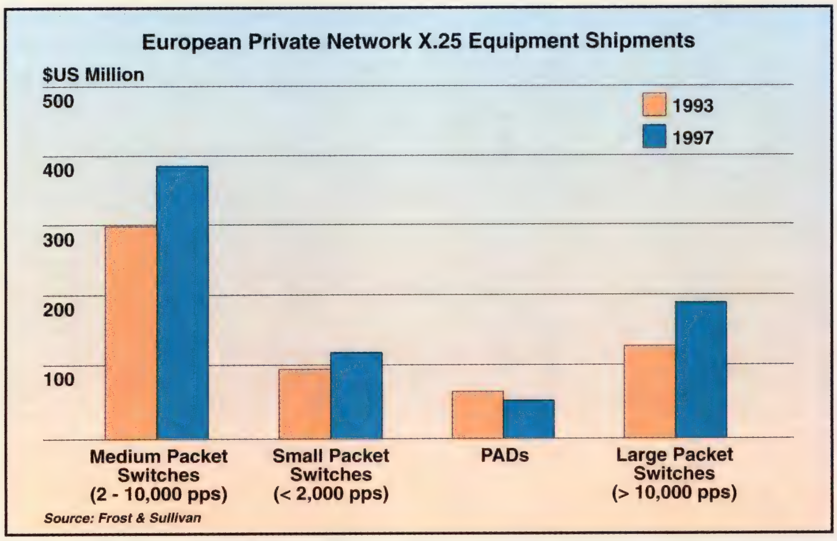
By incorporating all the networking and communications equipment needed for a premises LAN - including hubs, bridges, routers, analysers, and management tools - the superbox should make LANs reliable enough to handle critical applications.



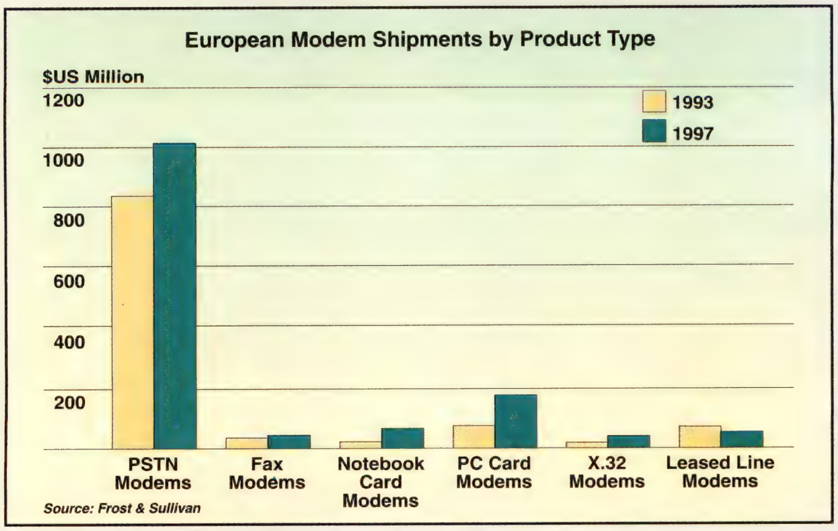
Market Watch


PC LAN Market: Revenue Forecasts (Europe 1991-1997)

Source: Market Intelligence *Note: All figures are rounded*


European Private Network X.25 Equipment Shipments

Source: Frost & Sullivan


European Modem Shipments by Product Type

Source: Frost & Sullivan

tion version of the wiring hub: The intelligent hub. By adding a processor and memory to their passive devices, hub makers created smart products that took an active role in monitoring the LAN for problems. This active control of the LAN environment provided a big boost to LAN reliability. Bytex, Cabletron, Chipcom, David Systems, and SynOptics Communications proved particularly adept at adding LAN management to their smart hubs.

Vendors also used the built-in intelligence to create logical LAN segments within a single hub. Under this approach, a single large hub can be segmented into several smaller LANs. Bytex took this concept to its limit with the Series 7700 intelligent hub, which has a matrix switch that lets managers create logical LANs involving any device attached to the hub. These logical networks can be changed via software from a management station.

Wiring hubs brought order to individual departmental LANs, but they fell short of solving several performance issues involving the backbone LAN that links the departmental LANs in a building or campus. In early LAN designs, larger LAN backbones, like their LAN segment counterparts, snaked their way through buildings and campuses, with bridges at each floor or site connecting a given segment to the backbone (see Figure 2 on page 33). The arrival of intelligent wiring hubs eliminated some of the equipment needed for premises backbones. First, managers put all bridges in one wiring closet, creating a star network of LAN segments. Makers of smart hubs joined with bridge and router suppliers to develop plug-in cards that would run bridge/router software in the hubs. Logically, the bridge/router was an independent device plugged into the LAN-in-a-box, but its inclusion in a single device simplified LAN management.

This trend toward integration has led internetworking vendors to rethink their strategy and is making possible the development of the all-in-one LAN superbox. For instance Cisco, the leading maker of routers, has been moving away from manufacturing standalone routers and is concentrating on developing its internetworking software. Instead of building boxes, Cisco is making its software easier to port to other vendors' platforms. This approach will enable Cisco to supply bridge/router software to a number of superbox vendors. Proteon also is focusing on making its router software more portable.

Another problem affecting the performance of premises backbones involves the throughput available on the backbone. Ethernet backbones are limited to a maximum throughput of 10Mbps, while Token Ring backbones operate at either 4 or 16Mbps. For bandwidth-intensive applications, 10 or 16Mbps is not much, particularly if a backbone is tying together an entire campus.

One solution to this performance problem is to segment the LANs into smaller

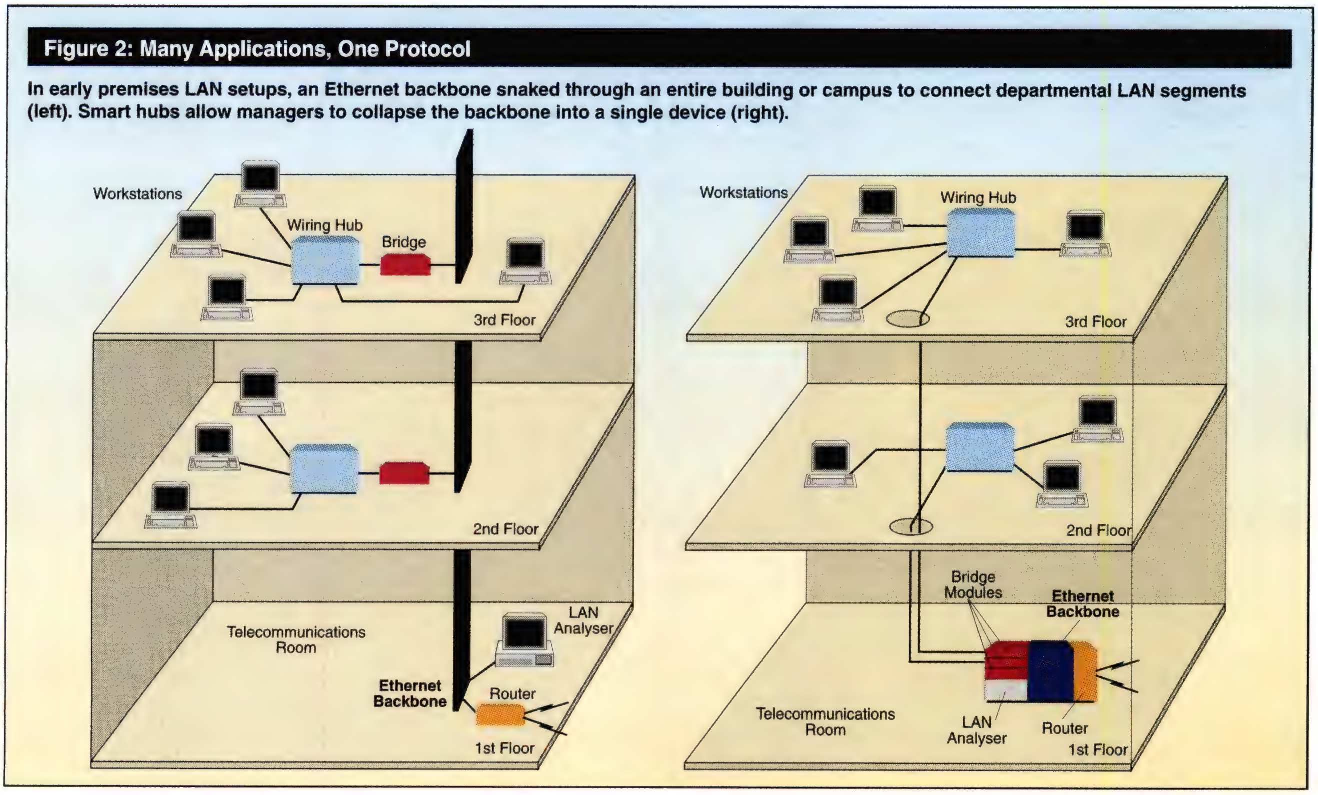


Figure 2: Many Applications, One Protocol

In early premises LAN setups, an Ethernet backbone snaked through an entire building or campus to connect departmental LAN segments (left). Smart hubs allow managers to collapse the backbone into a single device (right).

pieces tied together with very fast bridges and a high speed bus that acts as the backbone LAN. LAN segmenting can be done with conventional bridges and routers, but a group of internetworking vendors developed a specialised device called a switching hub that performs the functions of both a hub and a bridge — at about one-third the cost of using conventional hubs and bridges. This technique has been used primarily for Ethernets; suppliers of Ethernet switching hubs include Alantec and Fibronics International. IBM and Chipcom recently announced that they will use LAN segmenting techniques for Token Ring LANs.

Another way to boost backbone performance is to use high speed broadband technology, such as ATM switching. With existing ATM technology, routers and hubs can be linked at high speeds in a star configuration. ATM devices now available can connect as many as 16 routers or hubs at speeds of 100 to 155Mbps for each connection. This means that ATM already surpasses the bandwidth offered by FDDI products, which provide a maximum of 100Mbps for all connections in the ring. ATM allows each device to use the full 100 to 155Mbps of bandwidth available to it, while FDDI requires devices to share its 100Mbps of bandwidth. Eventually, users will be able to deploy a network of ATM hubs for their campus LANs.

The makers of ATM products, including Adaptive, Fibermux and Fore Systems, are lining up the support of vendors of conventional hubs and routers. Cabletron, Chipcom, and several other hub makers have announced that they intend to add ATM interfaces to their products next year as a first step. After doing this, they plan to use ATM switching inside their hubs. Cisco is among those router vendors that also plan to add an ATM interface to their products next year.

The emerging LAN superboxes also will make the jobs of managing and monitoring premises LANs much easier. The future of network management in the LAN superbox can be spelled out in four letters: SNMP. Management information bases (MIBs) have been developed to control most of the items that will be included in the superbox. The few items not yet covered by MIBs, such as Token Ring error monitors and ATM switches, should have MIBs in the near future.

With the collapsing of the LAN backbone, the need to bring LAN and WAN analyser tools into existing hardware has become more acute. Many hubs already feature built-in analysers. This integration is enabling makers of analysers to focus on improving their software rather than worry about hardware issues.

Bringing it All Together

The hardware platform that brings all this functionality together will make its own contributions to network performance and reliability. Superbox platforms will offer many redundancy features, including dual power supplies, dual buses or redundant switching fabrics, dual control and management processors, and dual connections to other superboxes. Vendors are likely to offer a range of redundancy choices, letting users decide how much to spend on network protection.

As noted, hub vendors are angling to provide the base hardware for the LAN superbox. Ungermann-Bass has recruited Advanced Computer Communications (ACC), Olicom, and Wellfleet Communications as its internetworking partners and Protools as its LAN analyser supplier. Cabletron is teaming up with Cisco for routing and Novell for its LANtern monitor. Router software from Cisco also is being used by Chipcom in its superbox. Bytex's partners include Wellfleet and Crosscomm. ATM hub vendors have yet to sign up any development partners, but observers expect alliances to form soon.

Along with all the essential components for premises LANs, some vendors are leaning toward adding a few extra ingredients in their superboxes. Terminal servers and directories are likely to be included in many products. Some developers plan to open their platforms even further to accommodate file, print, and data servers. Ungermann-Bass, which is basing its superbox on its Access/One architecture, has lined up Novell, Lotus Development, and Microsoft to add LAN servers to its product. Like bridge, router, and analyser cards, these servers will plug directly into the superbox's backbone. Ungermann-Bass says it will accommodate any component that can add value to its superbox, including IBM SNA gateways and video servers.

Other superbox developers are limiting their products to communications and networking functions. Chipcom, for instance, has said that its superbox will not be opened up to include file servers. The thinking on this side of the fence is that applications should be kept separate from the premises infrastructure. Users, of course, will decide which approach makes the most sense for them.

Robin Layland

Protocols

OSPF Routing: Better, But Not Good Enough

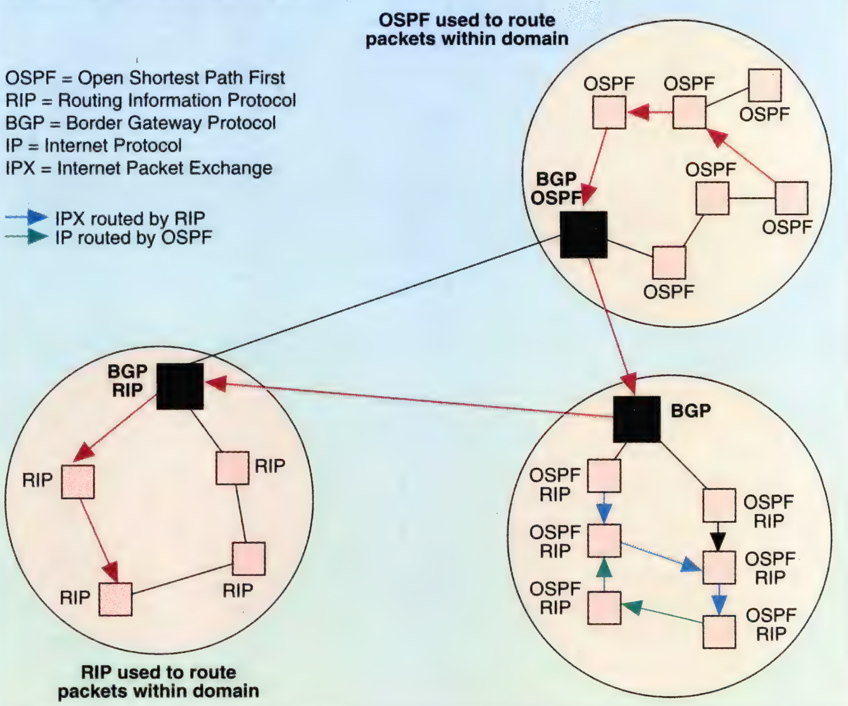
The open shortest path first (OSPF) routing protocol, expected by many to be the predominant router-to-router protocol for years to come, now appears destined to fill only a limited role in LAN internetworking. Although it is a marked improvement over the routing information protocol (RIP) it is intended to replace, OSPF has critical weaknesses that will keep it from serving as the linchpin protocol in large internetworks. In fact, even as router vendors roll out OSPF offerings, developers are working on next-generation protocols that address issues that OSPF can't handle.

OSPF has two main drawbacks when it comes to large internetworks: It handles only internet protocol (IP) traffic, and its routing algorithm isn't powerful enough for the larger internetworks envisioned by many corporate network managers. Because of these limitations, OSPF is likely to settle in as a complementary routing protocol in LAN internetworks.

The internetworking scenario now envisioned by many network planners has routing protocols such as OSPF, RIP, and Cisco Systems' Interior Gateway Routing Protocol (IGRP) handling traffic in specific segments, or domains, in a larger internetwork. These domains will be linked by protocols built specifically to handle interdomain traffic. One such protocol, the exterior gateway protocol (EGP), has been in use on the Internet since 1984.

Getting There's Half the Fun

In a complex internetwork, different routing domains have paths determined by an interior router-to-router protocol such as OSPF or RIP. Paths between domains are determined by interdomain protocols such as BGP.


OSPF used to route packets within domain
OSPF = Open Shortest Path First
RIP = Routing Information Protocol
BGP = Border Gateway Protocol
IP = Internet Protocol
IPX = Internet Packet Exchange
IPX routed by RIP
IP routed by OSPF
OSPF
OSPF
OSPF
OSPF
BGP OSPF
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OSPF RIP
OSPF RIP
RIP used to route packets within domain

The US-based Internet Engineering Task Force (IETF) is now developing a replacement for EGP, called the border gateway protocol (BGP). BGP uses a new type of algorithm to make routing decisions. This algorithm, the policy-based algorithm, enables network managers to factor a wider range of information into the routing process. With policy-based algorithms, for example, routers can take into account such factors as the relative importance of network traffic in determining paths through the network.

The possibility also exists that tomorrow's routing protocols will be based on proprietary technology. One proprietary protocol worth watching is Digital's Integrated IS-IS, which is based on the OSI intermediate system-to-intermediate system (IS-IS) protocol. Integrated IS-IS is one of the few routing protocols that can handle both intradomain and interdomain routing.

Picking a Protocol For Internetworking

PROTOCOL	ALGORITHM TYPE	STANDARDS BASED	PATH OPTIONS	PROTOCOLS SUPPORTED	DOMAIN
Routing Information Protocol (RIP)	Distance Vector	Yes (some vendors offer proprietary extensions)	Single Path	AppleTalk, IP, IPX	Intradomain
Interior Gateway Routing Protocol (IGRP)	Distance Vector	No	Multiple Paths	IP, OSI CLNP	Intradomain
Open Shortest Path First (OSPF)	Link State	Yes	Multiple Paths	IP	Intradomain
Integrated Intermediate System-to-Intermediate System (IS-IS)	Link State	No	Multiple Paths	DECnet, IP, OSI, CLNP	Intradomain or Interdomain
Exterior Gateway Protocol (EGP)	None	Yes	Single Path	IP	Interdomain
Border Gateway Protocol (BGP)	Policy Based	Yes	Multiple Paths	IP	Interdomain

Protocol Shift

Despite the inherent limitations in OSPF, significant numbers of users are installing the routing protocol, according to router makers. Some vendors report that as many as 30% of their customers are using OSPF, even though most vendors are just now getting around to offering OSPF implementations. Proteon introduced the first OSPF router two years ago, and others have joined the market since. Cisco and Wellfleet Communications have been shipping OSPF routers for more than a year.

The interest in OSPF reflects the fact that corporate internetworks are fast outgrowing RIP. The main difference between OSPF and RIP is the type of algorithm used to determine the optimal network path between two nodes. RIP uses a distance-vector algorithm; OSPF is based on a link-state algorithm.

Link-state protocols out-perform distance-vector protocols in a number of ways.

Continued on page 38

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Applications

How the ASC Swings on VINES

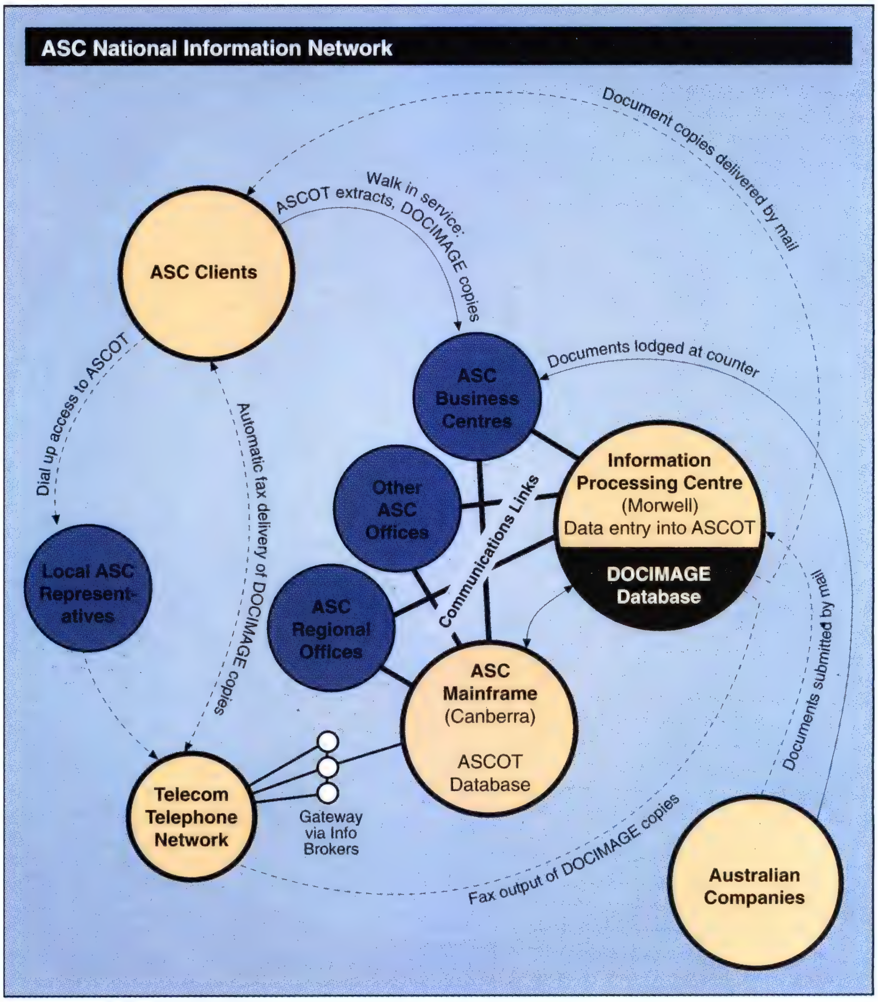
The creation two years ago of the Australian Securities Commission (ASC) from a hotchpotch of State-based and national corporate regulations (and regulators) would simply not have been achievable in the days before enterprise-wide distributed computing. Its IT infrastructure is, literally, the springboard from which the ASC meets its charter to enforce the Corporations Law; and from which it maintains information on nearly 900,000 Australian companies.

Formed in response to the corporate excesses of the 1980's, planning for the establishment of the ASC began in July 1989. From the outset it was recognised that the new body's corporate and IT plans (Corporate IT Plan or CITP) were of necessity interdependent: As a result, the entire IT infrastructure was designed, developed, installed and operational by January 1, 1991 — the ASC's birth. And so successful has that infrastructure been that earlier this year it gained the ASC a Gold Award at the Government Technology Productivity Awards.

Built with Banyan's VINES network operating system, SynOptics hubs and Telecom ISDN links, the ASC's IT infrastructure is based around two linked networks: A star-based SNA 3270 network providing Australia-wide dedicated terminal access to a Hitachi Data Systems (HDS) mainframe located at the federal Attorney General's Department in Canberra; and a national TCP/IP network running VINES 4.11 which interconnects 1,200 PC users in each of the ASC's 21 sites with all system resources, including the Attorney General's mainframe.

The accent here is on Australia-wide, mirroring the jurisdiction of the ASC. ASC staff and the public have to be able to get at ASC-held information as easily in Townsville as in the Chairman's offices in Melbourne and Sydney. For example, an investigator in Melbourne will need information about a company headquartered in Perth; an investigator based in Sydney but working temporarily in Darwin will need to login to their local server in Sydney; or an investigation team working across several States will need access to the same resources (resources are users, printers, file systems, applications and so on) wherever they reside — without delays or complicated access methods.

Knowing from the outset exactly what kind and scope of services the network had to enable was a boon for designers, and not having to incorporate disparate or obsolete existing systems into the new infrastructure was a bonus. But, being so pivotal to the regulator's operations and ultimately its credibility, there was some pressure to get the network right first go. Almost two years since it was turned on, the network architecture has proved itself and, with ISDN reliability improving daily, the ASC network is nearing its target availability of 99.9%.


ASC National Information Network
Document copies delivered by mail
Walk in service: ASCOT extracts, DOCIMAGE copies
ASC Clients
Dial up access to ASCOT
Automatic fax delivery of DOCIMAGE copies
Documents lodged at counter
ASC Business Centres
Other ASC Offices
Communications Links
Information Processing Centre (Morwell) Data entry into ASCOT
DOCIMAGE Database
Local ASC Representatives
ASC Regional Offices
ASC Mainframe (Canberra)
ASCOT Database
Documents submitted by mail
Telecom Telephone Network
Gateway via Info Brokers
Fax output of DOCIMAGE copies
Australian Companies

From the public's point of view, two ASC services critical to Australia's corporate and securities sectors are ASCOT and DOCIMAGE which together add up to the definitive collection of information on all 900,000 or so Australian companies. ASCOT resides on the HDS mainframe, and is accessed by either the SNA or VINES network. It supports more than 800 simultaneous users and processes more than 800,000 transactions per day, with 90% of responses taking less than two seconds.

DOCIMAGE, the ASC's document storage and retrieval service has, since it began, accumulated more than three million documents (12 million pages). The imaging system that supports DOCIMAGE consists of networked mid-range Sun workstations with optical storage, document scanning and peripherals. The system, which has the capacity for 50-60 million pages stored on optical disks, can manage queues of 10,000 requests or 100,000 images per day; and can print up to 200 requests or 2,000 images from any one ASC Business Centre in a single day, usually within 10 minutes of request. Document images are retrievable via terminal request to the mainframe with the image being faxed to client offices; and via Unix workstations or PC workstations (through PC-VIEW, a facility of DOCIMAGE) on the VINES network.

The Banyan Advantage

Clearly the performance of the ASC is tied to a performing network. According to Mike Shelley, one of the people who established the ASC network and now Manager, Technical Support, what was needed was a distributed computing approach across the entire network, in contrast to a distributed approach for each of the 21 sites (LANs) linked by a WAN. He explains it this way: "There are 21 LANs if you like (linked via ISDN and using TCP/IP), but their resources are distributed across the 40-odd servers on the national network. Users are able to use a resource at any location regardless of where it lives. The LANs are all interacting at any one time — virtually on line to each other constantly." VINES, was, in Shelley's view, the painless way to achieve that.

When VINES came onto the market around 1984 it was a product ahead of its time. Banyan's Technical Manager, Harry Carter says that "the key thing for Banyan [in 1984] was to release a product that did more than just basically put a server on a network and connect everybody up via a cable to let them share files and printers. Our focus was to provide some host connectivity and some wide area networking, and the bottom line technically is that our protocol architecture is designed for internetworking as much as it is designed for networking."

VINES' wide area distributed nature — Banyan describes this as resource transparency — comes from its directory system, StreetTalk. StreetTalk is, as no other naming systems are according to Carter, a directory system that names every resource that is either managed or used on the network.

Underneath StreetTalk, VINES manages the location independence of the resources by taking a view from the top. It can do that because it is built on top of Unix. Says Carter: "[Building on Unix] has given us a lot of economies of scale; it has given us the ability to build a view to the network resources rather than to the physical server or the physical client, and to make the services available across the network without having to deal with what server they run on. They can all communicate without the user administrator being involved."

Security, a big issue for Australia's sole corporate regulator, is handled very well by VINES according to Shelley. "Compared to Novell where you log into a local server and every other server you want to access, when you log in on Banyan your access rights relate to the things you have in your login profile, and the things that are in your profile can be from anywhere around the company."

Improved Availability

The network is nearing its reliability target but it has taken a while to get there. According to David Burns, the ASC's data communications specialist, LAN reliability has never been a problem but WAN availability was poor in 1991. "It has dramatically improved throughout 1992."

All site LANs are 10Base-T Ethernets based on SynOptics hubs, and downtime on each is close to zero. WAN connections are via 3Com brouters connected to the ISDN. Large sites have Jtec Macrospans multiplexing the different data channels onto a Macrolink; and the smaller sites have the brouter connecting to Philips Terminal Adaptors, which in turn connect to Microlinks.

The first WAN problem — an obscure VINES connectivity problem — arose during network installation. Burns explains that there was difficulty communicating with the Queensland servers. "At the time we didn't have a clue what the problem was, but it was very frustrating not being able to access the servers and do comparatively simple operations over the WAN to that site. That went on for about a month while we lodged problem reports with Banyan."

But, while looking at another connectivity related problem, Burns discovered the

Continued on page 41

Technology Update

■ 100Mbps Ethernet: Startup Grabs the Lead

Move over FDDI, watch out ATM — here comes 100Mbps Ethernet, the new contender for the supply of high speed services to the desktop. In a presentation to an IEEE 802.3 committee made early last month, representatives acting on behalf of 3Com, SynOptics Communications, Sun Microsystems Computer and LAN Media Corporation (LMC, a startup company focussing on 100Mbps Ethernet) spelled out a set of technical objectives the vendors believe are necessary for a 100Mbps Ethernet standard over unshielded twisted pair wiring. The four '10/100Mbps Ethernet Migration Objectives' endorsed by the vendors include preserving current Ethernet media access control layer protocols while scaling speed up; providing a low-cost migration path; keeping as close to the original Ethernet specification as possible; and providing support for existing cabling types. But while the group is pushing for a consensus approach to the new high speed, high bandwidth networking technology, California startup Grand Junction Networks has forged ahead by announcing its Fast Ethernet 100Mbps product for unshielded twisted pair cabling. The 100Mbps Ethernet is feasible because many corporations are changing their LANs from a bus topology to a star topology; thereby reducing the effective network diameter from 2,500 metres to 250 metres and allowing data transfer rates to increase by a factor of 10, says Howard Charney, Chief Executive Officer of Grand Junction. "Alternative high speed solutions such as FDDI are well suited for backbone and long distance applications. Fast Ethernet is ideally suited for desktop deployment because it is based on Ethernet," he maintains. According to Grand Junction's co-founder Dr Bob Metcalfe, who designed Ethernet in 1973 and later went on to found 3Com, the biggest advantage Fast Ethernet offers is its compatibility with current 10Mbps applications. By using the same packet formats as the current IEEE 802.3 Ethernet standard, current 10Mbps applications and products will be compatible he says. "If we did not provide compatibility with the current Ethernet applications we would be a dead duck in the water. If a corporation decided it needed its network to operate more quickly without going for a complete overhaul, Fast Ethernet is cheaper that FDDI or ATM and is totally compatible."

■ Beyond CDDI: 155Mbps Over Copper

Before the American National Standards Institute ratifies a standard for carrying 100Mbps FDDI traffic over copper wiring, a move is already under way to push copper data rates higher — to at least 155Mbps. The advance comes in the form of an IBM-backed proposal to add extended shielded twisted pair (STP) performance specifications to the US Electronic Industries Association/Telecommunications Industries Association's EIA/TIA 568 Commercial Building Wiring Standard. The specification would qualify STP wiring for carrying 155Mbps asynchronous transfer mode traffic, according to supporters. Other applications could include carrying multimedia traffic and 600MHz broadband video signals. Existing STP cables will conform to the specification without modification, says IBM, but a higher performance version of its 1984 hermaphrodite shielded data connector will be required.

■ X.400 Group to Speed E-Mail

A new group has been formed to develop a standard way to send X.400 electronic mail across ordinary telephone networks. Called the Asynchronous Protocol Specification (APS) Alliance, the group was formed in late October at the Electronic Messaging Association conference by Isocor, an e-mail developer, and Norwegian Telecom. If an APS specification results, the group will make it available to the public domain and will propose it to the CCITT for formal standardisation. Other companies involved in the alliance include Apple, Microsoft, British Telecom, DBP Telekom, Transpac and Thompson Syseca.

■ Breaking Through the Gigabit Barrier

Wave division multiplexing (WDM), which someday may enable WANs to operate at gigabit, terabit and even petabit speeds, has moved one step closer to reality, according to researchers at the University of Massachusetts and San Diego-based Qualcomm Incorporated. The researchers have figured out a way to use cheaper, simpler switches than the ones currently required for WDM networks, according to a paper they recently published in *IEEE Transactions on Communications*. WDM uses optical switching to carry high speed signals, each of which is assigned its own light frequency. Although the ultimate goal is to use only optical switches for WDM networks, such switches are difficult to build; today, prototype WDM nets use electro-optical switches. Unfortunately these switches can't keep up with WDM: They're not fast enough to retrieve data from one frequency channel, demodulate it, and remodulate it onto another channel. Another difficulty with electronic switches is that each signal needs to be converted from optical to electronic form, switched, and reconverted to optical form. To solve these problems, the researchers propose a test network, called Lightnet, that uses a single light frequency, thus eliminating the need for much of the frequency conversion in the network. The use of a single frequency enables Lightnet to employ mechanical optical switches, which are cheaper and easier to design than all-optical ones — and don't require signal conversion from optical to electronic form and back again.

Applications

Monsanto Gets the cc:Mail Message

While Monsanto Australia Ltd (MAL) had enjoyed savings of up to 28% on its communication costs since introducing electronic mail more than two years ago, the firm's IT department wanted to achieve even greater efficiencies. This meant replacing its two existing e-mail systems with a single easy-to-use PC-based package, simplifying e-mail traffic both domestically among its 100 employees, and internationally among over 40,000 Monsanto staff.

Monsanto is a $9 billion a year giant involved worldwide in the production of food product ingredients (including the successful NutraSweet sugar substitute), pharmaceutical products and agricultural products (such as Roundup). In Australia, its agricultural and pharmaceutical divisions are based in Melbourne while NutraSweet is based in Sydney. As the organisational structure of Monsanto is so diverse, the parent company encourages a good deal of autonomy within its subsidiaries, including the freedom for each to determine their own IT strategies.

Away From IBM

Monsanto Australia's domestic mail system was WordPerfect Mail, while it used IBM System/36 Mail to communicate with Monsanto's offices elsewhere in the world. The e-mail package used to communicate with the outside world was tying up 30 to 40% of the System/36's processing power.

"The dual system was very unsatisfactory," said MAL's manager of Management Information Systems, Sim Choo. "It was very, very frustrating for our users to utilise both systems so we started to look for a single alternative."

Initially, MAL wanted to use WordPerfect Mail to replace System/36 Mail, but the product's ability to dial in from remote locations was limited at the time, said Choo. Instead, he began examining Lotus cc:Mail, the e-mail package Monsanto's head office in St Louis was using. The package was duly adopted and MAL's Melbourne office now acts as the hub of an electronic mail system used by Monsanto's employees in both Australia and New Zealand.

"We're currently not back to using 100% of our minicomputer's processing power, so we've effectively extended its life cycle by introducing a PC-based mail system," said Choo, who added that MAL had previously been considering replacing the System/36 with a more powerful box, but that decision had now been deferred.

Today cc:Mail is used within Monsanto's chemical and agricultural divisions in Melbourne and at the firm's Sydney NutraSweet office. There, said Choo, cc:Mail was installed on a Macintosh-based network with no additional hardware costs.

Besides e-mail between its own staff, the introduction of a cc:Mail add-in, cc:Fax, has simplified fax traffic within MAL, Choo said. All incoming and outgoing faxes are now directed through MAL's Melbourne cc:Mail gateway and sales staff, who often work from home, can dial in anytime, day or night, to pick up faxes and e-mail messages.

"We've removed the cost of a second telephone/fax line to the houses of our sales staff, and removed the need to outlay funds for fax machines," said Choo.

The company is also participating in two pilot EDI projects with one of its major customers and a supplier, which Choo prefers not to name. Initially MAL is looking at automatic processing of product orders between itself and the customers, using Telecom's EDI service, Tradelink. "When this is fully operational we expect to be able to have a major reduction in the amount of paper work we do and to eliminate duplicate processing and have all orders and invoices handled electronically," said Choo.

Spreading the Word

So successful has the cc:Mail installation been at MAL, Choo has travelled to Monsanto's agriculture research centre in Japan to help implement cc:Mail and put in place Monsanto New Zealand's cc:Mail system. "We are aiming at getting everyone in Monsanto worldwide to move over to cc:Mail, although as yet it's not officially a company standard," said Choo.

The Australian operation is encouraging as many other Monsanto subsidiaries to move to cc:Mail as possible, because Choo believes the transition to a single standard will bring tangible benefits to the entire company. With more than 20,000 of its 40,000 staff worldwide using PCs, Choo claims Monsanto currently uses every imaginable e-mail system. As a result, the parent company maintains a dedicated mainframe in its St Louis head office, the sole function of which is to interpret and retransmit messages between Monsanto offices worldwide using a software package called SoftSwitch.

The electronic transfer of data and the increasing use of the Melbourne gateway to pass on messages between staff (as opposed to conducting long distance telephone conversations) saw the company save $70,000 in communication costs during 1991. Choo believes these savings and greater can occur worldwide within Monsanto with the introduction of a standard e-mail system.

"Overall we expect 1992 to show another improvement in communication services [in Australia] even after the service improvement and cost reduction we achieved in 1991 through the introduction of System/36 e-mail," said Choo.

Darren Edwards

OSPF from page 34

With distance-vector protocols such as RIP, the main factor that determines the optimal network path is the number of hops. This means, for instance, that a six-hop link always will be selected over a seven-hop link, even if the latter uses higher-bandwidth connections that can send the data more rapidly. Link-state protocols take factors such as link speed into consideration when determining optimal paths.

Link-state algorithms also calculate optimal paths faster than distance-vector algorithms and use much less bandwidth when exchanging routing-table information. Distance-vector routers share information with neighbouring routers about network destinations and the distance to those destinations. Routers do not store entire paths in their tables; they record only the next hop on the way to the destination. Through repeated exchanges of routing tables between neighbouring routers, all routers on a network eventually know how to reach every destination. RIP routers are limited to 15 hops; OSPF, in contrast, can accommodate many more hops — the theoretical limit is 1,024 although the practical limit is lower.

Link-state protocols such as OSPF do not broadcast entire routing tables at regular intervals. Instead, they broadcast advisories containing information about changes in the links in the internetwork. The information garnered from these advisories is used to build a link-state database that contains information about all destinations and paths on the internetwork. Once all routers have the same link-state database, each router builds its own routing table.

Link-state advisories are broadcast only when a change occurs in the network. Typically, the time between broadcasts is about 30 minutes. What's more, only the changes are broadcast, rather than entire routing tables. This results in some dramatic bandwidth savings. Routers using RIP may exchange 10 Mbytes of routing information every 30 seconds for a moderately sized network. With OSPF, a 76-byte packet containing a new path would be transmitted only when a change in the network has occurred.

Link-state algorithms do require more router processing power and memory than distance-vendor algorithms. The time it takes to calculate shortest paths using a link-state algorithm is proportional to the number of routers. Doubling the number of routers on an internetwork — or connecting one internetwork with another to double the number of routers — doubles the amount of time it takes to calculate the paths. More memory is needed because the link-state database grows with the size of the internetwork.

Unlike RIP, OSPF allows for network load sharing. When two paths between two nodes are deemed to be of equal value, OSPF allows both links to be used to send data. Another key advantage that OSPF holds

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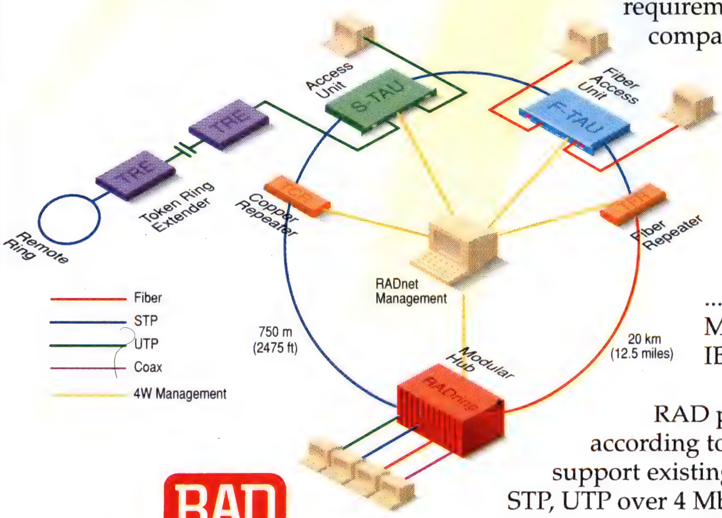

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over RIP is that OSPF offers routing based on upper-layer types of service (TOS). That enables the router to calculate separate sets of routes based on relative throughput, reliability, and delay in each link. OSPF contains three IP TOS bits, one for each of these parameters. Network managers can set these bits to produce up to eight separate routing tables. For example, one table could calculate a path for low delay, high throughput, and high reliability. Such criteria might send the data over a high speed circuit instead of a slower link, or it might route traffic over a more reliable, but more expensive, circuit.

Despite all these advantages, OSPF comes up short on two key counts. It handles only IP traffic, which means it cannot be used with such common proprietary LAN protocols as Internet Packet Exchange (IPX) from Novell and AppleTalk from Apple. Neither can OSPF handle traffic from OSI's connectionless network protocol (CLNP).

Although OSPF can handle bigger networks than RIP, the practical limit on OSPF network hops is a concern for larger internetworks. The limit depends on how often changes occur, the complexity of the paths within the network, and the time it takes to calculate new paths. The larger the network and the more complicated the paths, the longer they take to calculate. If changes occur faster than the time it takes for paths to be calculated, the network cannot function properly.

Because of these limitations, many users have been reluctant to replace their RIP routers with OSPF gear. One distance-vector protocol that continues to score high marks with users is Cisco's IGRP. In terms of functionality, IGRP falls somewhere between RIP and OSPF. Cisco's protocol can make routing decisions based on factors other than the number of network hops, such as internetwork delay, available bandwidth, traffic load, reliability, and the maximum packet size for a link. Like OSPF, IGRP permits multipath routing to a destination so that packets can take more than one path to reach a destination if the paths have equal value in terms of length, bandwidth, reliability, and delay.

Alternatives From Novell, DEC

Besides IGRP, two other proprietary protocols have garnered the interest of network managers. Novell is developing a proprietary link-state protocol for routing IPX. The new protocol, which may be available by year's end, is called NetWare Link State Protocol (NLSP). Novell will not say much about NLSP except that the OSI IS-IS protocol may be a technology source.

The other proprietary protocol to watch is Integrated IS-IS. Digital's protocol uses a link-state algorithm based on the OSI IS-IS routing protocol standard. While Integrated IS-IS is proprietary, the University of Wisconsin has developed an implementation of the protocol that is available via the Internet. Integrated IS-IS handles both IP and OSI routing protocols and DECnet. DEC also may bring other protocols into the fold, including IPX and Appletalk.

As internetworks grow, even the fastest converging, most efficient protocol will not be able to assimilate information about the entire internetwork. Rather than try to accomplish the virtually impossible, developers are now focusing efforts on dividing the internetwork into smaller areas — domains — that are then connected to one another. Specific routers within a given domain are assigned to link to similar routers in other domains. These routers get updates from their counterparts in other domains to determine the best path for data moving from one domain to another.

The use of domains in internetworks offers several big advantages. For one, the intradomain routing tables in a given domain are not affected by changes in other domains. If a router is added to one site, this information does not have to be relayed back to every router in every site. Only the routers responsible for interdomain routing would

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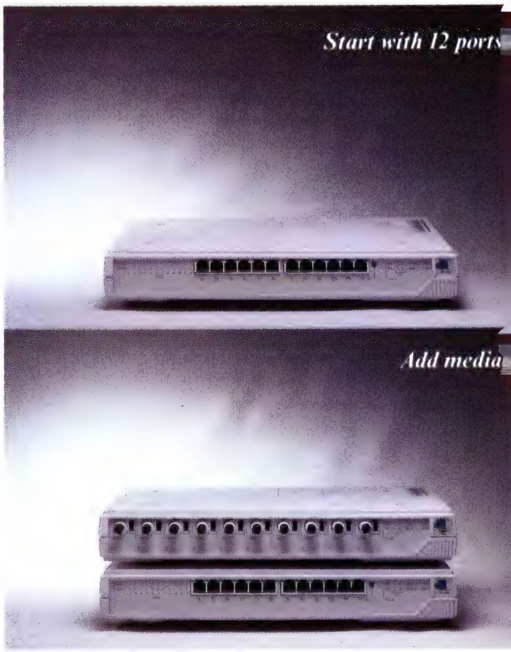

need this information. This helps cut routing table calculations considerably.

Within each domain, network managers can set routing policies specific to that domain. For instance, a site that is using OSPF routing can set TOS bits to use less costly routes for low-priority traffic. At another site in the same internetwork, RIP routers can be used for non-IP traffic. The corporate backbone that connects these sites may be administered by yet another set of criteria.

As noted, OSPF's use of TOS enables managers to base routing selections on reliability, delay, and throughput variables. But there are other factors that could affect routing decisions, such as address restrictions, time of day, authentication requirements, and actual link charges. Policy-based algorithms enable routers to make routing decisions based on this type of information.

Routers that exchange this type of information with routers in other domains must run interdomain routing protocols. Since 1984, the exterior gateway protocol has been the most common interdomain routing protocol on the Internet. EGP is used for communications between the core Internet routers that form the Internet's backbone. EGP has very limited policy-based functions. It allows domains to define portions of their connectivity databases that can be shared, but it does not allow the use of TOS options in other domains. EGP updates are sent to neighbouring routers at regular intervals. In the update, each router tells the other which networks it is directly connected to. This 'reachability' information is used to calculate routing paths.

To bring interdomain protocols in line with more sophisticated internetworking requirements, the IETF has developed a new interdomain routing protocol, the border gateway protocol. BGP uses IP as its transport protocol and it communicates with BGP peer routers, which can either be within the same domain or in another domain. The primary role of BGP is to exchange network reachability information with other BGP routers. The reachability information includes such things as the full path that a packet must traverse to reach a network.

BGP is expected to replace EGP as the main interdomain protocol on the Internet. It addresses some of EGP's short-comings. For example, it uses policy criteria to determine the best path.

Many router vendors now have development programs for BGP under way. Cisco, Proteon, and Wellfleet all are working on or have developed implementations of the IETF's third version of the BGP standard.

Salvatore Salamone

ASC from page 37

fault. There are two 64Kbps links between Sydney and Brisbane because, says Burns, "it is more economical to use two single 64-Kbps links rather than one aggregated 128-Kbps link." But "the nasty effect that has is that packets travelling from Sydney to Brisbane can actually arrive in a different order to the way they are transmitted. Normally that shouldn't matter [with TCP/IP, it is acceptable for the network to resequence packets], but the way that Banyan's protocols fitted in with TCP/IP was such that they weren't handling it when packets arrived out of order." Banyan issued a site-specific patch to fix the problem.

Other problems were with ISDN technology in 1991 says Burns. "The Microlinks and Macrolinks were performing far below the quoted availability target; and the Macrospan's early software was unreliable."

The line problems were eventually improved by Telecom changing the ISDN routing and, when a new version of Macrospan software was installed the faults were substantially reduced says Burns. Importantly, that is faults between 8am and 8pm Monday to Friday — the hours within which the ASC measures network performance.

Shelley Spriggs

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Interop

APPI, ATM and CDDI Hot at Interop

In October 1990, 197 companies exhibited at Interop and 21,000 attendees walked through the doors. In October 1992, the statistics read 400 exhibitors and 40,000 visitors. Six year old Interop is unique because vendors wanting to exhibit their products must go 'on-line' on the Interopnet along with their arch rivals. But while the latest Interop (held October 26-30 at San Francisco's Moscone Centre) had the outward appearance of vendors and users 'interoperating' together, behind closed doors controversy flared between Cisco and IBM over how to send SNA traffic over TCP/IP networks.

At issue was the 'openness' of IBM's APPN (Advanced Peer-to-Peer Networking) SNA routing protocol. Originally developed for networks of AS/400 minicomputers but since extended, Cisco has led a groundswell of industry opinion that IBM has been too restrictive in allowing developers access to APPN specifications. High on its list of complaints is IBM's practice of charging a $US400,000 licence fee plus future royalty payments for access to its APPN Network Node source code. Licensees so far include NET, 3Com, Systems Strategies and Novell.

Consequently, Cisco Systems has sponsored the creation of an Advanced Peer-to-Peer Internetworking (APPI) Forum designed to develop an alternative spec. The Forum, which had its inaugural meeting at Interop, has as its founding members Alcatel, British Telecom, Cabletron, Cascade Communications, Cisco, Hewlett-Packard, Digital, Infonet, McData, Netrix, Proteon, SunConnect and SynOptics.

According to Cisco's Senior Vice President, John T. Chambers, the Forum's objective is to promote the internetworking of peer-based SNA applications. "I think that IBM's current practices with regard to APPN have not fostered the kind of dynamic development that we think the industry needs. In this multivendor heterogeneous environment just one vendor providing the solution is not what people are looking for and [a few other vendors] that can have solution next year is also not the kind of breadth that customers are looking for," he said.

Similar to APPN, APPI will combine internetworking features found in TCP/IP networks such as dynamic adaptive routing, and support for multiple media and protocols with SNA peer-to-peer networking. More than 100 people representing 17 companies attended the inaugural Forum meeting and Chambers expects that the group will be able to submit an APPI spec to the Internet Engineering Task Force (IETF) by the end of 1993.

In response, IBM announced at Interop that it would simplify its Network Node licensing program to make it more affordable. According to the company's Director of Network Services, Rick McGee, for the $US400,000 licensing fee, customers will be provided with 120,000 lines of code, technical support and updates. Or vendors can obtain the IBM's APPN book of specifications and write the code themselves. Thirdly, McGee said that the second APPN meeting will be held to discuss problems with APPN and how each vendor feels the protocol could be improved.

"We have been catching a lot of flack from people about APPN, but I have yet to have a chance to explain the details of it," said McGee. "I think that we are offering other vendors a fair price for the amount of code and specification they are getting. We did not join the APPI Forum because we feel that we have a product that will be available six months to a year before APPI is, so why do something twice." At Interop, IBM demonstrated its 6611 router working with 3Com's NetBuilder II router sending APPN traffic from booth to booth.

SynOptics' ATM Investment

Asynchronous transfer mode (ATM) technology was another hot topic at the show with companies such as SynOptics, Fore Systems, Adaptive, Cisco, Retix, Wellfleet, and Hughes LAN Systems releasing products or announcing strategies.

Amongst the product leaders, Fore Systems, Adaptive and Hughes LAN Systems each mounted well-attended demonstrations of their ATM product lines. But while the newly released products gained much attention, some industry figures sounded a note of caution.

According to Rob Newman, ATM Product Manager for SynOptics Communications but better known for his work in developing the QPSX protocol, users should be cautious in their approach to early-generation ATM solutions and contends that existing high bandwidth network schemes such as FDDI may be more viable in the short term. He says that FDDI is a much more mature technology and if users have a bandwidth problem now or next year then it is probably the best alternative. But by 1994, as ATM technology matures, the choice will be less clear and by 1995 he contends that ATM will be the best solution. But in the meantime, users should beware of high cost (SynOptics' goal is to drive the cost of ATM connections to under $US1,000 by 1995) and quick-fix approaches.

"There a number of different ways of building ATM switches. The way we've taken is Fast Matrix parallel switch architecture. That allows us multiple simultaneous communications through the switch," said Newman. The alternative backplane bus approach "will give you an easy start if you're a manufacturer but it doesn't scale." A 1.2Gbps backplane (adopted by Adaptive) "sounds a lot" but with each user taking 155Mbps congestion will soon become a problem, he says. And "there's a limit as to how fast you can clock a backplane — let's say 40MHz — so 1 or 2Gbps is all you can reasonably do for the next few years."

SynOptics' Fast Matrix approach has been developed based on the work of Dr Johnathon Turner at Washington University. The company has spent $US10 million over the last three years on the technology and has designed a chipset for its future ATM product line. According to Rob Newman, the basis of the approach as developed by Dr Turner is to run the internal switching fabric at a speed much higher than the sum of the incoming links and to randomise the distribution of the traffic across all possible paths. This distribution minimises the probability of two cells coming to the same output, but if that happens, the switch has an internal buffer to cope.

He points out that there is a key difference between ATM standards development and those developed for existing shared media. "What's being specified is the interface to the switch [rather than the whole protocol]." This allows companies like SynOptics to "choose the internal architecture of our switch independent of what's going on in the standards world — somewhat independent of standards development." Newman says that ATM standards need to cover three things: The connection from the application (either a workstation or router) to a switch; connections between switches; and connections to the wide area. In each case the key areas for standardisation are the physical interface, the ATM format and signalling.

CDDI Demonstrated

Also at Interop, Cabletron, Crescendo, and Silicon Graphics teamed up to demonstrate 100Mbps FDDI products over UTP wiring. Not to be outdone, SynOptics teamed with Network Peripherals to also demonstrate FDDI over UTP. Both demonstrations were based on MLT-3 encoding and stream cipher scrambling techniques, recently approved by ANSI's X3T9.5 TP-PMD Working Group.

"This demonstration is evidence that CDDI is here for the user today," said Jayshree Ullal, Vice President of Marketing for Crescendo. "The standard has evolved to the point where multiple vendor products can interoperate."

Amongst other key releases, Novell announced a new version of WorkPlace for DOS and unveiled LAN WorkGroup. Both products allow users to concurrently access both Unix and NetWare resources such as file access and printing. LAN WorkGroup enables users to install and maintain networks from a central location. LAN WorkPlace for DOS version 4.1 allows users to access Unix and NetWare network resources via TCP/IP protocol suites.

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Melfyn Lloyd

TCP/IP vs OSI

It is a common view that TCP/IP (Transmission Control Protocol/Internet Protocol) and OSI (Open Systems Interconnection) stand at opposite poles, with the first representing 10 million practitioners, while the second is a committee product, a promise for the future. TCP/IP and OSI represent differing protocols, and possibly differing views on how protocols should be agreed and specified. Nevertheless, the two may be closer to consensus than we had thought. Neither is a finished article; both are the subject of continuing efforts to improve computer communications, and it is necessary to look at what is being developed for the future in both domains.

For an organisation such as the CSIRO, working on solutions to business problems requiring R&D, the pressing issue is to ensure adequate testing of draft standards before they are set in concrete, whether they be OSI, TCP/IP or any combination of the two. Many recent articles have noted a movement towards consensus. Proponents from both camps are accepting a more peaceful coexistence, and many vendors offer the user a multiprotocol existence. User and vendor industry groups such as COS (Corporation for Open Systems) and NMF (Network Management Forum) now address TCP/IP-related issues alongside OSI. This peace of mind reflects the massive installed TCP/IP base that will not be upgraded overnight to an OSI solution. Further evidence of maturity can be identified in the plans for the TCP/IP-based Internet to host OSI related experiments in areas where it is recognised that OSI technology could be of benefit.

Considering the scope and scale of implementing an OSI and/or TCP/IP application, very few users can afford the risk of installing it directly as an operational system. A pilot study or prototype is recommended. The same logic applies to the standards themselves, especially when they began as paper specifications. CSIRO's experience, both through its Open Systems Program and as a financial contributor and significant user of AARNet (the Australian Academic and Research Network), has been that building and experimenting with test implementations of a draft standard is a prerequisite for quality, and indeed of properly understanding the standard concerned.

Melfyn Lloyd is the Program Manager of the Open Systems Program for the CSIRO's Division of Information Technology. The Division's Open Systems program plays a leading role in Australia in the design, development and standardisation of open and distributed systems such as electronic mail (X.400), electronic directories (X.500) and Open Distributed Processing (ODP). Lloyd has previously acted as Program Manager for a number of European Commission development initiatives and was a member of the UK GOSIP steering committee.

Two Different Approaches

Protocols are a set of rules or procedures to enable effective communication — both for people and for computers. The process of developing 'standards' differs between the Internet and OSI communities, a distinction which may have some impact on the eventual content of the protocols. TCP/IP grew from the research community, with a claimed tradition of gaining community support through extensive implementation and experimentation before draft standards are laid down. The TCP/IP method can be contrasted to the more formal approach used for OSI, with phases of committee work in ISO and CCITT developing and refining paper standards. The TCP/IP-based Internet community view this somewhat critically as a case of developing and revising standards documents prior to implementation. Claimed flaws in this approach include the tendency for a committee to meet all possible requirements and interests, and the resulting costs and time scales for reaching a consensus. The latter point is also a major strength for OSI.

A further complaint against OSI is the difficulty of implementing a 'moving target,' with regular cycles of amendments and revisions to the core standards. Interestingly, it has been noted with some disdain that the process for TCP/IP specification/standardisation is moving towards that used for OSI!

The OSI Promise

OSI holds out the promise of international standards adopted by all major suppliers — enabling users to connect dissimilar machines with vendor-independent freedom. Over a decade has been spent in ISO committees developing a variety of communication standards, yet OSI suffers an apparent lack of uptake among users and developers; applications are often early implementations of the standards.

OSI covers a whole range of ISO and CCITT standards, providing LAN and WAN orientated solutions at the lower end of the OSI model and applications at the top. Most user focus has been at the applications end, where there seems to be a number of phases of OSI uptake — differentiated in time either because of standards availability or a lack of real market demand or product. The first (and crucial) phase provided the basic stack support for OSI operation over WANs (X.25) and LANs (802.3) coupled with the critical applications of MHS (electronic mail) and FTAM (File Transfer), all available from a wide range of vendors, and in use with many organisations and sites around the world. The latest entrant to this phase is X.500 Electronic Directory Services.

A number of standards were published but failed to make similar impact, including ODA (Office Document Architecture) and VTP (Virtual Terminal Protocol), neither of which have seen widespread implementation, although VTP does appear in the US GOSIP requirements. In greater demand is EDI, with a number of commercial offerings, some operational systems, and many pilot user projects in progress.

Two critical areas of OSI resulted in reasonably stable international standards that are the target of intense implementation around the world. Transaction Processing (TP) is intended to support key business areas such as the finance and airline industries, offering functionality similar to and in excess of IBM's LU 6.2. TP is an example of the historical difference in emphasis between OSI and TCP/IP. The latter, originating in research establishments, has not been made to address transaction processing, while the government and vendor backed OSI is entering the competitive domain of proprietary commercial networks such as IBM's SNA.

The second key area is Network Management, with a stable protocol platform,

Continued on page 48

X.500 Electronic Directory Service

Alan Lloyd

This is one of a series of open systems tutorials by Alan Lloyd, Strategic Systems Group Manager for Datacraft Australia. Alan represents Australia on numerous international standards bodies and is the co-author with Gary Dickson of *Open Systems Interconnection* (Prentice Hall, 1992).

The OSI Electronic Directory Service (EDS) is defined in the CCITT X.500 series of recommendations and their equivalent ISO standards, ISO 9594 parts one to nine. Basically, the directory is a knowledge base serving as a phone book for computing networks in which objects have user friendly names. The directory permits the storage of information that is referenced with either a formally structured name or a user friendly name (an alias).

An X.500 directory permits direct 'white pages' style look-ups, browsing of information that matches an imprecise query, and 'yellow pages' style searches using a filter. The directory is thus capable of providing and managing comprehensive information regarding network users, systems and applications. A range of security features means the X.500 directory can also provide information for authentication and security related services.

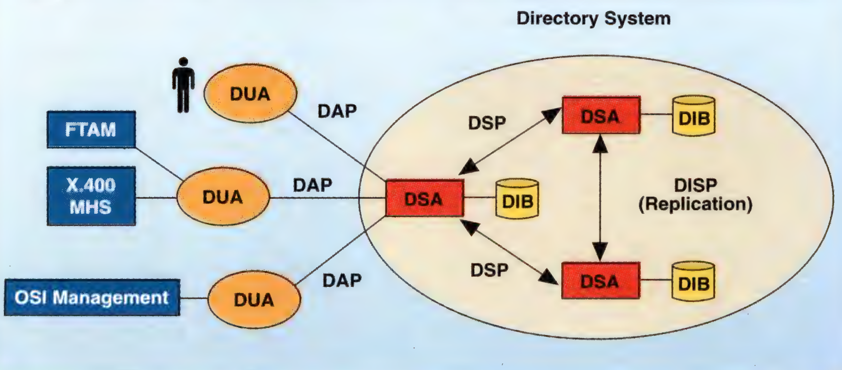
X.500 EDS, although analogous to white and yellow pages usage, has a much wider capability. The X.500 EDS is a major part of the OSI distributed system design and provides a distributed knowledge base for the system. Naturally, a single, centralised directory service is a straight forward function. However, in any system where distribution of information and the management of distributed information is introduced, complexities are also introduced. It is this distributed capability of the X.500 EDS that forms the bulk of the latest standards.

The first comprehensive release of the X.500 EDS standards was the 1988 version which specified a general directory service. It is from these standards that implementations of X.500 EDS directories are being produced. The 1992 version of X.500 EDS added an number of significant, but optional features to the 1988 version dealing with directory replication and distribution and the management of the directory information.

There are three major components of the directory (see Figure 1). The Directory System Agent (DSA) manages the information in the directory. The Directory User Agent (DUA) provides user access to the services of the directory and the Directory Information Base (DIB) associated with each DSA, provides the repository for directory information. The term Directory Information Tree (DIT) is also used within the directory service, but this is related to the structure and organisation of the DIB.

Three protocols are used by the directory. The Directory Access Protocol (DAP) provides the means for DUAs to communicate with DSAs. The Directory System Protocol (DSP) allows DSAs to communicate with one another for distributed directory operations. Finally, the Directory Information Systems Protocol (DISP) is used between DSAs for the transfer of directory information during the replication process. The significance of the DSP is that it enables access to distributed directory information held in different DSAs. Directory information may therefore be located in a number of interworking directories in different cities, states and even countries. Users and other applications access the services through DUAs. OSI applications are increasingly using the services of a directory because it facilitates peer connectivity and the management of distributed information such as X.400, OSI management and FTAM.

Figure 1: X.500 Directory Systems Architecture

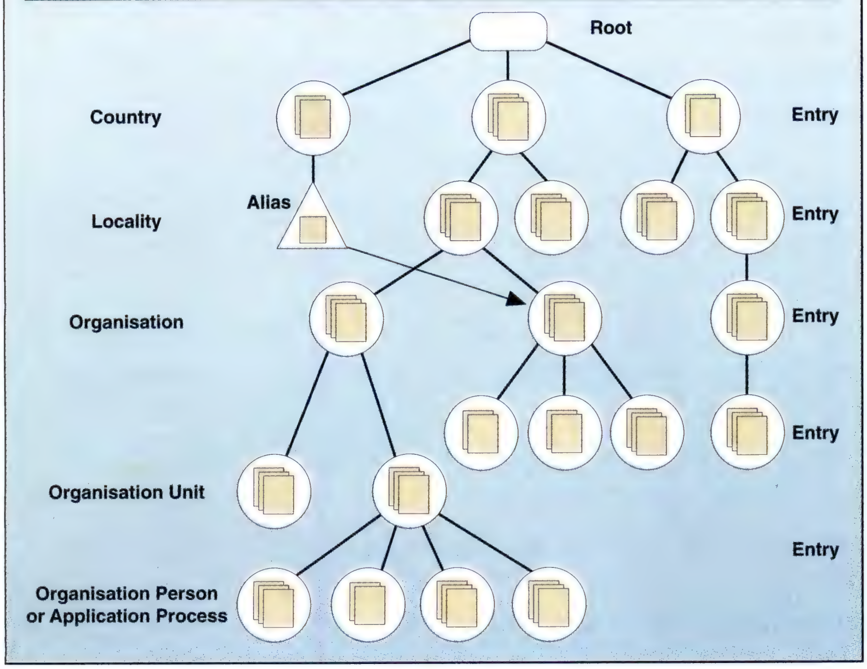


A single isolated X.500 directory is referred to as centralised directory. A telephone company may own a single national directory to permit a single point for international access to the national service, but private companies own and administer their own company wide directories. In theory, the private directories will be linked as subordinates to the national directory. This is the distributed aspect of a directory. Distributed directories contain a unique part of the DIB — they own their own name space. However, this directory hierarchy does not inhibit direct access by a local user to the private directories if it is permitted. The same rules can be applied to direct access to a directory and to access from a 'superior' directory service. This configuration is referred to as distributed directories.

Knowledge bases are held at a specific geographic location. This is fine if the users are in proximity to this facility. However, because the users are generally dispersed and usually some form of backup redundancy is required for the information, knowledge bases are replicated and interlinked. This directory configuration removes the issue of long distance access costs and the issues of concurrent and redundant information. However it does introduce information consistency and administration issues. This configuration in terms of directories is referred to as shadowed or replicated directories.

Because of the requirements of directory ownership, replication and distribution, a lot of the X.500 standard is directed at this arc-

Figure 2: Directory Tree and Naming



hitectural level. The remainder is concerned with what is actually stored in a directory and how it is accessed.

Accessing Information

The Directory Access Protocol is used exclusively between the DUA and DSA. The DUA is always the initiator of the connection. The DAP represents a directory service with each service containing a range of parameters which specify the operation. For example, the services specify what type of information is wanted (i.e. a filter), the name of the object(s) (i.e. where to start) and the scope of the operation (i.e. a range specification for navigation through the DIB from the initial object).

The basic services are Read (entry), Compare (entry), Add Entry, Remove Entry, Modify Entry, ModifyRDN (Modify the Name) and Abandon (an operation). The Search service requests the DSA to scan the DIB starting from a selected entry in the DIB, using filters, and return the contents of entries. The List service requests the DSA to list the names of the immediate subordinate entries of the specified entry, using filters if required.

The DSP protocol is used between DSAs and mirrors the DAP protocol plus other parameters to enable chained operations. The services names are modified to reflect this. Chained Read and Chained Search are two services. In resolving DUA queries, a DSA can refer the DUA to other DSAs in the DAP response or chain or multicast the request to other DSAs using the DSP. The nature of this action depends on the parameters provided in the DUAs request (Service Controls) or in the originating DSA's capability and knowledge about other Directory System Agents. DSA information may require replication for backup purposes, for optimised access when concurrent accesses are high on a single directory and where geographic distribution of the DSA data is required.

The information in the directory is organised as an inverted tree, referred to as the Directory Information Tree (DIT). The actual information which each DSA stores is the Directory Information Base (DIB). A Directory System Agent may hold the complete DIB (in centralised operation) or a fragment thereof (in distributed operation). Directory entries are nodes in an inverted DIT and in most cases have superior and subordinate entries. The top level entry in the directory is referred to as the Root and the lowest level entries the leaves, or leaf entries.

Entries, or nodes, are accessed by a name or a series of name components, starting from the root downwards. Each entry in the DIB has a Distinguished Name (DN) which can be constructed of one or more Relative Distinguished Names (RDNs). Note that 'relative' means relative to a position in the DIB tree. An example of a directory tree is shown in Figure 2. A naming hierarchy starting at country and ending in organisational person is typical. The DN is the total name from country to organisational person used to navigate to an entry, and the RDN is a component of the name.

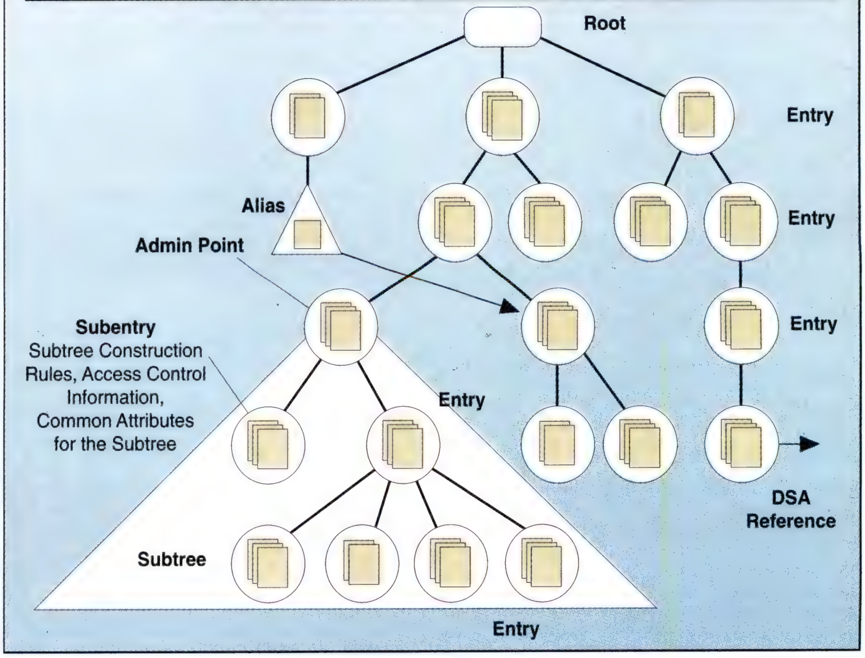
The directory information model is enforced by a set of rules. The structure of the directory tree and an entry's relative position is enforced by name bindings which ensure the logical hierarchy of the entry types. For instance, a country entry cannot be put under a personal entry. The internal structure of entries is also enforced by object class definitions and attribute specifications.

These rules ensure the design of the directory tree and the nature of the information held is kept intact. It is little use keeping arbitrary information in an arbitrary way in an arbitrary place.

The X.500 standards define approximately 20 common object classes and 60 attribute types (e.g. country, organisation, etc.). Other information types can be added if the product implementation permits.

In the initial version of the X.500 EDS standards, the user data held in a DSA had a

Figure 3: Directory Tree Management (Adminstration Points)


Root
Entry
Alias
Entry
Admin Point
Entry
Subentry
Subtree Construction Rules, Access Control Information, Common Attributes for the Subtree
Entry
DSA Reference
Subtree
Entry

number of associated attributes stored and managed by the DSA to permit knowledge of other DSAs and internal management of the DIB itself. With the additional requirements and refinement of replication and fragmentation of DIB data, the entry itself has been reclassified as a DSA Systems Entry (a DSE). A DSE can contain entry attributes for the user data and operational attributes to support the administration of the entry and the replication and fragmentation management of distributed DSAs. A DSE may have entry attributes, operational attributes or both depending on its role within the total DIB.

To identify an entry with its role and DIB location and its effect in the scheme of the total DIB, a number of DSE entry types have been defined. The root type identifies the top of the total DIB across a chain of DSAs. The glue type provides a null type entry to link DIB fragments. A context prefix holds the naming context of the subordinate DIB. An entry type DSE is a DSA user's data entry, while an alias type references an alternate entry with a natural name.

A subordinate type provides a reference to an entry in a subordinate DSA. A Non Specific Subordinate Reference (NSSR) type entry references a subordinate entry in another DSA by the DSA name. A superior type is used in conjunction with the root type to indicate that this entry is the root entry within this DSA but has a superior entry in another DSA. A cross reference (X-ref) provides a reference (for optimisation) into another Directory System Agent.

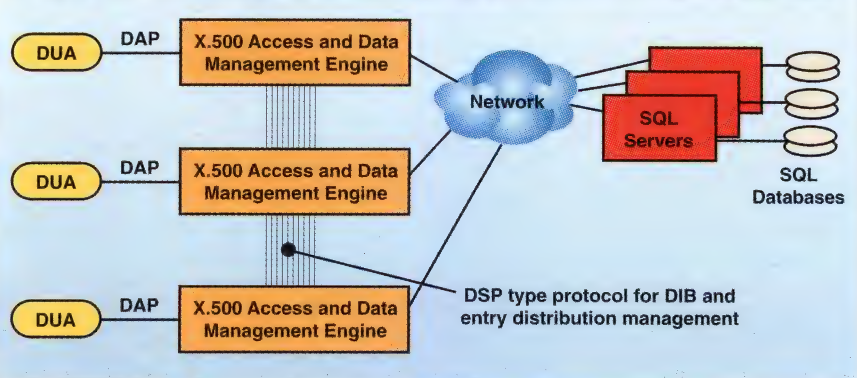
The administration point identifies the start of a DIB subtree (within a DSA) for a specific DIB administration entity. The administration point may also contain entry information. These administration points permit fragments of the DIB to be allocated to specific set of access controls, administration policy or schema constraints. Subentries are located under the administration entry and define the bounds of the subtree(s) associated with the administration point. Subentries can also define the schema rules and syntax of the subtree specified.

A shadow indicates the entry is a complete or partial copy of the original entry. An immediate superior provides a reference to an immediate superior entry in another DSA. A subordinate alias is a subordinate reference to an alias. Finally, a RHOB contains operational binding information for DSA-DSA association.

Some of the above entry types can hold user entry information. Many of the entry types within a directory are defined to hold knowledge references for distributed DSAs and are not used in a centralised DSA.

For DIB management, the administration point and subentry types of entry permit the specification of part (or all of) the DIB with respect to its structure, rules, access controls and common attributes. These entries should be seen as parallel entries to the user information entries that are used by the DSA to control and manage that part of the DIB to which they are attached (see Figure 3).

Figure 4: Logically Distributed Directory Service


DUA
DAP
X.500 Access and Data Management Engine
DUA
DAP
X.500 Access and Data Management Engine
DUA
DAP
X.500 Access and Data Management Engine
Network
SQL Servers
SQL Databases
DSP type protocol for DIB and entry distribution management

The X.500 directory is a powerful technology for distributed systems. As with X.400 messaging, the directory in its true distributed form will take time to be deployed as the global directory service. Also the distinction between the X.500 standard and the way technology serves the implementation will also need consideration. For example, a DSA can be implemented as an X.500 server with a number of back end SQL servers as the storage system. Also a distributed DSA system can be a number of networked SQL servers with a number of communicating front end X.500 processors/servers which interconnect to control the replication and distribution aspects of X.500 and its DIB (see Figure 4).

It is probably in this form that the 1988 version of X.500 will adopt and evolve to the distribution capability and functionality of the 1992 version.

Research Notes from page 45

CMIP (Common Management Information Protocol), being used to support an object-orientated view for managing the entities connected by a network. Other Open Systems standards best described as work-in-progress include RDA (Remote Database Access) and ODP (Open Distributed Processing). A number of early RDA implementations have been trialled; ODP is still in the early stages of standardisation, and the publication of a stable standard appears to be some years away.

TCP/IP's Shortcomings

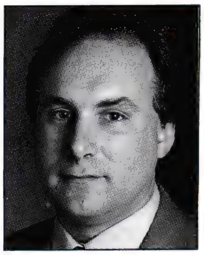
The original intentions for TCP/IP were to connect mainframes in the US at sites undertaking research sponsored by DARPA (the US Defense Advanced Research Projects Agency). The TCP/IP-spawned Internet now spans the globe, and connects individual workstations at thousands of sites. Previously the domain for research, the network is now commonly used for direct commercial and educational benefits. It encompasses a worldwide network supported in Australia through AARNet.

Internet must be described as a phenomenal success but its roots show in today's usage pattern: Almost every research organisation in the world is a user, and many Internet networks have an 'acceptable use' policy which restricts purely commercial traffic. It can be argued that, comparative to its long active life, Internet's exposure to business usage has been limited. The great expansion of demand for connectivity has stretched initial design decisions, and requires urgent action to provide sufficient addressing space and efficient routing approaches for future growth. Developments in the specifications are controlled by the US-based Internet Engineering Task Force (IETF), which is now considering a number of solutions (including one derived from the OSI domain) to provide sufficient addressing flexibility for the future.

In one specific area related to resource discovery it is accepted that OSI has developed functionality not available from Internet: X.500 Electronic Directory Services. The standard provides for distributed directories that can link up to provide a consistent global database — the equivalent of 'white pages' for computer connectivity. This area represents the emerging view of coexistence, with Internet developing a pilot for directory usage based upon the X.500 standard.

While the OSI/Internet standards continue to evolve, there is a real opening for Australian user organisations to play a role in the standardisation process, particularly through prototyping partnerships with the CSIRO which provides feedback to the numerous standards committees. The European Community has moved firmly to control its own destiny by specifying that any public procurement above 100,000 ECUs must conform to Open Systems; there is a similar need for Australians to safeguard our user interests amidst the many pressures.

LAN VIEWS



Tortoises, Hares and the GUI Stuff . . .

Graeme Le Roux

I'm beginning to think the acronym MIPS should be redefined as 'Mostly Irrelevant Processor Statistic.' The straight processing power available in any machine above an 80386 running at 25MHz is several times that required by most users. What has a far greater impact on the responsiveness of a desktop machine and the network it is attached to is the *throughput* of the various sub-systems that comprise the machine and the way in which system and application software uses those sub-systems. This is most obvious in a graphical user interface (GUI) environment. There are five major subsystems in a network workstation that limit responsiveness of a GUI environment. These are graphics, disk, memory, network interface and of course the system bus.

In a GUI environment a user's screen image — desktop if you like — is composed of a large number of, mostly regular, filled or unfilled shapes. The orientation, location and order in which they are overlaid is completely arbitrary and changes asynchronously. In other words if you have 16 open windows and you 'double click' the top left hand corner of the middle one the GUI environment has to work out how the screen image must change, which sections have to be re-drawn to change it and then it has to actually draw the new image. In a PC the limiting factor in this process is, in most cases, the speed at which the screen can be re-drawn. The reason for this is that the central processing unit (CPU) has to 'spoon feed' a relatively dumb graphics controller. A more efficient way to perform this operation is to build a graphics controller with the ability to draw regular shapes built in. In this way the CPU need only specify the location and basic properties of each regular shape that must be drawn, the graphics controller does the rest. The advantage of this, apart from the graphics controller being much faster at drawing the screen, is that the CPU is freed sooner to carry out any command that might result from the user 'double clicking' the window. To the user the machine is therefore much more responsive.

> *"In many cases money spent on fast CPUs is wasted."*

A similar argument can be put for efficient disk sub-systems, the best example being the SCSI bus architecture. Lets say you copy several files from one disk to another. In older PCs this would require reading the files from the source's disk to a buffer in memory and then writing the buffer back to the destination disk. This laborious process would be under the control of the CPU. In other words the user would be unable to do anything. If, for example you started a copy operation you could not then 'double click' a window and have the screen re-drawn as I've described above. With a SCSI architecture, used properly, the copy process would involve the CPU telling the SCSI controller to copy a block of data from one disk to the other. The SCSI controller would then complete the process and signal the CPU that it had done so. This process would be repeated until all files had been copied. The result of this approach is that the CPU issues an instruction to the SCSI controller and while it is waiting for the SCSI controller to signal that the command has been completed it is free to issue commands to the graphics controller. As a result the user sees the copy process and the screen update happen, apparently simultaneously. CPU speed is irrelevant to the process.

What can slow up a process such as the one I've described above is *bus speed*. There is a difference between the *clock speed* at which a CPU is running and the speed at which a system, and at times its memory bus, is run (or more precisely clocked). For example an EISA bus is clocked at 8MHz whether it is in a 20MHz machine or a 50MHz machine. However the throughput of an EISA bus, measured as the amount of data it can transfer in a given time is much higher than an ISA bus which, in clones, may be clocked at as much as 10MHz. Put simply the more intelligent and efficient a PC's sub-systems are the more system resources are available for processing. In a network context that means assembling or disassembling data packets, calculating CRCs and passing data to and from the network hardware. There are also ancillary tasks associated with sharing network resources, checking access privileges, etc. Such tasks are, of necessity, CPU intensive, however they still only represent a small percentage of available CPU time on most machines.

In many cases money spent on fast CPUs is wasted. Worse still money wasted on fast processors is money that is unavailable to be spent on transmission systems equipment, server resources and support personnel and equipment. The result is that users, who have 'fast' machines perceive the network as slow — especially if their applications are server based — and unreliable while administrators can't get funds to make the network reliable. Even if the administrator succeeds in increasing the reliability of the network users will still perceive it as slow.

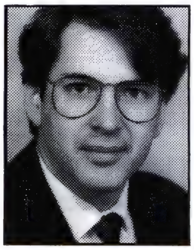
Limited available funds also result in a limited amount of money being spent on each machine and the machines being expected to have a longer life. This is resulting in the purchase of lower quality machines that, while stable enough in a low duty cycle environment, are not well suited to several years of continuous, high duty cycle usage. This is just the sort of usage that a typical GUI workstation gets, particularly if that workstation is called upon to function in a peer-to-peer environment. In such an environment the workstation also acts as a server that allows it to make its resources available to other workstations or 'peers' on the network. It may be called upon to act as a message transfer agent or a message store. It may use a remote resource, such as a backup device on a scheduled basis. In either case it will be required to run substantially longer and work substantially harder than in a non-peer-to-peer environment. This is likely to result in more frequent hardware failure.

Quality hardware with a lower processor speed, which will survive this environment, can be bought at similar cost to 'faster,' lesser quality hardware. If such quality hardware is chosen on the basis of its sub-system throughput, upgrade availability and its general suitability to the GUI it will run rather than on CPU speed, it will in most cases, do the job just as well as lesser quality machines. It is also likely that the supplier of such systems will be around when you do need service, spares or upgrades. There are times when brute processing power is required, there are times when cheaper hardware is more than adequate, however for most commercial applications money is better spent on reliability and intelligent engineering than on a CPU that just runs its self test very fast.

Graeme K. Le Roux is a Director of NSW-based Moresdawn Pty Ltd and specialises in local area networks consulting services.

INTERNETWORKING VIEWS

ATM's Biggest Benefit: Better Net Management



Nick Lippis

Over the past year, I've written extensively about the many ways that asynchronous transfer mode (ATM) technology will change the nature of corporate internetworking. I've demonstrated ATM's architectural advantages over competing approaches such as FDDI. I've examined at length what I considered to be ATM's chief benefits — its ability to deliver vast amounts of bandwidth in scalable amounts. No one likes to make mistakes, but I have to say I was wrong. ATM's biggest benefit isn't the extra bandwidth it provides. ATM actually does something even better: It makes corporate networks more manageable.

To be sure, the need for greater bandwidth is a real one. Net managers are deploying backbone networks at an unprecedented rate to interconnect corporate LANs. The resulting rise in bandwidth only makes the need for better management more acute. Complex internetworks inevitably bring multiple (and often incompatible) addressing schemes, topologies, and routing algorithms. In addition, internets make it more difficult to locate computing resources. These problems can be solved to some extent by implementing a common directory service — but making incremental improvements to existing gear goes only so far. Enter ATM technology.

ATM greatly improves net management by simplifying LAN interconnection. ATM-compliant hubs now on the drawing board will allow connections to be made between any two ports on the hub — regardless of whether the attached devices reside on Ethernet, Token Ring, or FDDI networks. Further, ATM hubs will logically map the physical address of an end-node (a 48-bit Ethernet address, for example) to the various ports on the hub, thus furnishing true any-to-any connectivity.

This means ATM hubs can offer management capabilities beyond anything available today. Let's assume a workstation is attached to an ATM hub that also links several Ethernet, Token Ring or FDDI LANs. The hub's switching mechanism will be able to link the workstation to any of the LANs, at any required bandwidth. The workstation might connect to the Ethernet LAN at 10Mbps, say, or to the FDDI LAN at 100Mbps. Now let's assume the user of the workstation has to move from the first floor to the second floor of an office. With today's LANs, this might involve pulling new cable and changing logical addresses in both the workstation and server software. With an ATM hub, the move is much simpler: A net manager seated at a centralised management console clicks on the workstation icon, moves it to the new location, and voila — the entire connectivity map is re-established in real time.

> *"ATM network management will make it just as easy to relocate many users as it is to move one."*

There's an even bigger benefit for workgroups: ATM will make it just as easy to relocate many users as it is to move one. Moving workgroups and reassigning access rights will become increasingly important capabilities as users start discovering the resources available to them on corporate internetworks.

Change management this easy is even more important when it comes to servers. Today, to insure adequate performance, servers and clients must be located near each other. With ATM hubs, network managers will be able to place servers in a central location for improved security and ease of administration (the 'centralised distributed' architecture) — without sacrificing performance.

ATM also will bring about a major shift in the way LANs are used. Today's LANs serve two main purposes: To link users in departments and to link LANs as backbones between departmental hubs. ATM LANs will gradually supplant other topologies on the backbone, relegating FDDI, Ethernet, or Token Ring to providing interfaces to the backbone. One inherent advantage of ATM for backbone networks is that it is not a shared LAN technology; it dedicates the full bandwidth of each network segment to each attached device. Coupled with the rapidly falling cost of 10Base-T connections, ATM will make it far easier to dedicate FDDI's 100Mbps, or Token Ring's 4 or 16Mbps to individual users, each on their own network segments.

Just as ATM will extend connectivity options in hubs, it also will offer greater topology independence in backbone networks. ATM hubs will be able to establish star, ring, point-to-point, mesh, or multipoint configurations, or any combination thereof. That will make it easier for net mangers to select the topology that makes sense given a network's traffic patterns.

So where does ATM stand in terms of implementation? Some ATM LAN hubs already are shipping, including the ATMX from Adaptive and the ASX-XO from Fore Systems. The long list of vendors planning to ship ATM products sometime in 1993 includes BBN Communications, Cisco, David Systems, Fibermux, Hughes LAN Systems, Retix, SynOptics, 3Com, Ungermann-Bass and Wellfleet Communications.

Still, many things must be done before ATM is as widely used as Ethernet or Token Ring. Among the missing pieces are an SNMP management structure; standard interfaces that connect non-ATM hubs to ATM hubs; interfaces between ATM hubs; interfaces between ATM hubs and cell-based services offered by telephone companies. Various standards bodies, including the ATM Forum, are working on these. Perhaps the most interesting standards effort is being conducted jointly by Apple, Bellcore, Sun, and Xerox. These vendors are putting together a document that specifies an architecture for ATM LANs. In many ways, this joint effort is similar to the one that produced the basic Ethernet LAN spec back in 1981 — and that launched the market for Ethernet technology.

Another problem with ATM is the lack of real-world experience. No one yet knows what effect cell loss will have on client-server applications, and whether requests for retransmissions could degrade performance to unacceptable levels. It's also unclear how ATM hubs will support broadcasting and multicasting, which are musts for client-server applications. Essentially, there will be two types of ATM hubs. One type will use computer-based buses to connect ports. The other type of ATM hub will use some sort of non-blocking cell relay switch. Hubs that use computer-based buses may be the better choice, since buses inherently support the connectionless communications needed for broadcasts and multicasts. Non-blocking cell relay switches are inherently connection-oriented, and thus will require additional capabilities to support broadcasts and multicasts.

Nick Lippis is principal consultant with US-based Strategic Networks Consulting. He specialises in LAN-to-WAN interconnection architectures and implementations.

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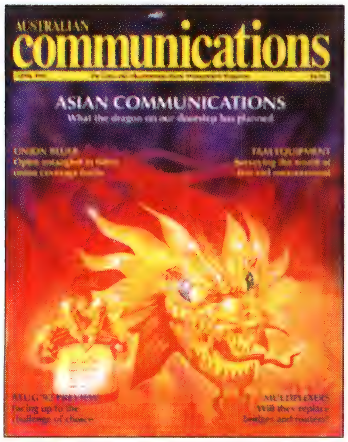

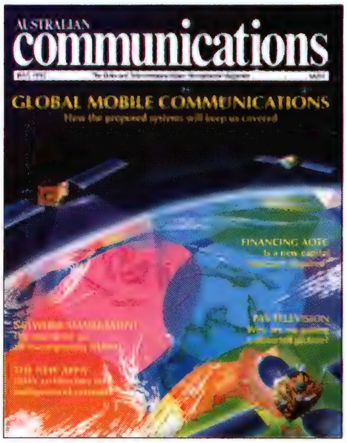

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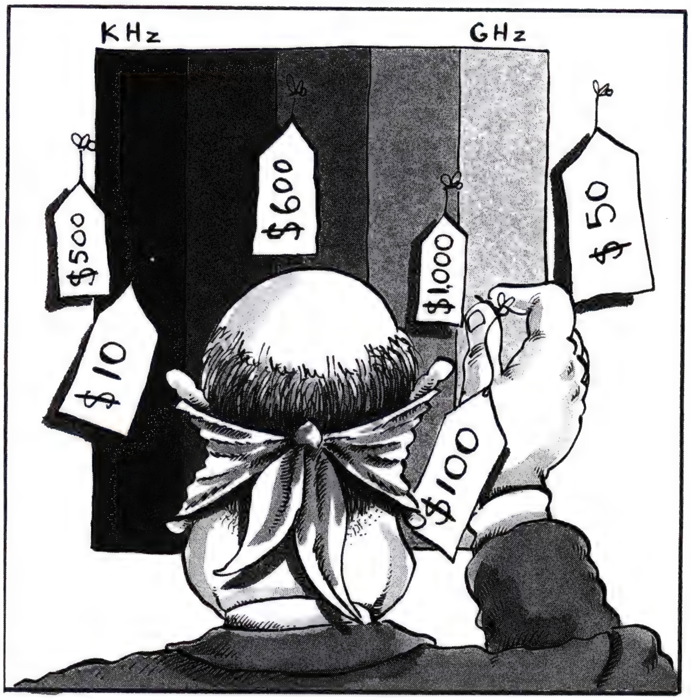
Radiocommunications Policy Makes Waves

Government reform of management of the radio frequency spectrum is well underway. Peter Leonard looks at the announced reforms and problems yet to be addressed.

The house of the law has many dark and mysterious corners. Before the watershed of the 1989 reforms, telecommunications law was one such corner. 1993 may come to be seen as the year that radiocommunications last joined broadcasting — always a contentious field — and telecommunications in the public spotlight.



The reasons can be readily identified. Many of the new service delivery technologies use radio rather than cable: Digital cellular (GSM); wireless PABX and LANs; new personal communications systems; global satellite services; trunked voice and data; and narrowcast audio and video services. Enhanced audio and video broadcasting also create new spectrum demands for familiar service types. There is no frequency band currently unutilised: Demand can only be met by reassignment of frequency bands. So how are competing demands balanced?

L'Ancien Régime

The Radiocommunications Act 1993 (Radcoms Act) takes a traditional administrative approach whereby the Minister has an absolute discretion to grant, or not to grant, an apparatus licence to users. An apparatus licence authorises the operation of specified radcoms equipment, for a particular frequency, geographic location and use. Licences are only granted to users for apparatus utilised to provide a service in accordance with the spectrum plan and any relevant band plans. Licences are issued over the counter on a first-come first-served basis. Most licences are annually renewable, for a fee fixed annually. They are non-transferable. Although there is no automatic right of renewal, licences are invariably renewed unless the relevant band is being reallocated or interference problems cannot be resolved. Similarly, licence transfers associated with transfers of businesses are invariably approved.

To enable users to plan services, the Act also allows the grant of frequency reservation certificates (FRCs). FRCs are issued after frequency coordination to see whether interference would result from use of the frequency in the manner intended. Although there is no guarantee that the holder of an FRC will be granted a licence, the Minister will grant a licence in accordance with an FRC unless there is a real question as to the applicant's bona fides — for example, if the Minister believed the applicant was 'banking' frequency for subsequent trading or to block competition.

Licence fees have been an odd mixture of administrative cost recovery (e.g. CB radio licence fees) and market-related revenue generating (e.g. cellular mobile and microwave multipoint). As fees adjust annually at the Minister's discretion, radcom licensees take the risk that fees can dramatically increase. This is fine so long as your competitors pay the same fees or the frequency cost is a small part of overheads. It becomes more of a problem when some competitors use non-radio technologies, and hence have entirely different cost structures, or the frequency cost is very substantial. From the Government's side, it faces the problem of how to adjust fees to fully reflect the opportunity cost of radio spectrum, which steadily increases through greater demand and the possible use of new, less bandwidth hungry transmission technologies. Hence the pressure for change.

Transition by Stealth

The first change, which was almost totally unnoticed, occurred last year when as part of the second telecommunications carrier licensing process, the Government introduced multi-year fixed fee spectrum licences for the GSM bands. Holders of spectrum licences are free to use a defined segment of the spectrum within a specified geographic area to transmit signals, provided these signals do not exceed specified levels beyond those boundaries. Although the telecoms carriers were licensed spectrum for a particular purpose (via public mobile services), spectrum licences may or may not be restricted to a particular use. The key difference between spectrum licences and apparatus licences is that under the former the user is free to determine where and how services are provided within the broad radio frequency parameters.

The second change was transfer to the new Australian Broadcasting Authority (ABA) of responsibility for planning radcoms broadcasting bands as assigned to it by the Minister. As well as longer term allocations to traditional broadcasters, the ABA can make parts of that band available for temporary allocation — for example, use VHF/UHF frequencies for narrowcast services, pending allocation of further broadcast licences. Although the *Broadcasting Services Act* (BSA) does not give the ABA power to licence the frequencies (as distinct from the services), the Minister may chose to delegate power to issue radcom licences to the ABA.

The third change was an amendment buried in the consequential amendments to the BSA allowing the Minister to introduce 'price-based' allocation of radiofrequency — note, not limited to broadcast bands. The Government could use this power to introduce price-based allocation immediately if it so wished. The last change, yet to be implemented, was heralded by the Minister's September 1992 Statement on 'Spectrum Management Reform.' The legislative amendments were being drafted at the time of writing and will be implemented as a new *Radiocommunications Act*.

Après Le Deluge

Key points of the Government's proposed reforms are:

- FRCs will be abolished. Certificates already on issue will remain in force until their expiry, but will not be renewed.
- The new Spectrum Management Authority (SMA), following its establishment in July 1993, will review the existing administrative licensing and pricing system to 'streamline licensing and pricing arrangements, to simplify apparatus licence categories and adopt a transparent licence fee structure.'
- The current system will continue to apply in relation to each frequency band until the Minister determines that the frequency band is converted to the market system and determines a marketing plan.
  The marketing plan may cover how spectrum will be apportioned between spectrum licences, the procedures and timetable for the sale of licences, and reservation of licences for public and community services. The Minister through this process may determine, and direct the SMA as to, the timing and nature of the market process.
- Incumbent users will be offered a spectrum licence based on the parameters of their existing apparatus licences, subject to payment of a conversion fee. No detail is given as to how the conversion fee will be calculated.
- Spectrum licences will be issued for a fixed term of up to 10 years and may then be reallocated through the market process. A spectrum licence therefore is like a leasehold, rather than freehold, title. The Minister's Statement notes that 'renewal upon expiry will depend on prevailing market and technological conditions, as reflected in the applicable marketing plan. There will be no automatic, or free renewal. Prior to the end of the licence term, expressions of interest will be sought for spectrum assigned to spectrum licences due for expiry, and a new marketing plan will be prepared.'
- Spectrum licensees will be able to change the nature of use, amalgamate, subdivide, sublicence, trade and mortgage spectrum licences.
- The *Trade Practices Act 1974* will regulate acquisition and trade in spectrum licences.
- The SMA will be able to buy spectrum licences in the market place and resume spectrum for fair and just compensation 'where this is essential to meet spectrum management objectives.'

Unresolved Issues

Many issues were not addressed in the Minister's Statement. First, the mechanism for determining the access price — auction, tender or over the counter — will apparently be determined on a case-by-case (band-by-band) basis and may be specified by the Minister rather than the SMA. The New Zealand and United Kingdom experience in spectrum tendering shows the difficulty, both for the seller and buyer, in valuing frequency. The optimal approach may differ from band to band, depending upon (for example) the extent of demand and the nature of competing uses. Will the Minister take the plunge and specify the mechanism to be used for each band converted to market-based allocation, or leave determination of the mechanism to the SMA?

Second, it will be difficult to determine an appropriate conversion fee for incumbent users and to strike the annual overhead charge (to cover the overhead costs of the SMA) which is 'to be shared equitably among all apparatus and spectrum licensees.' Is the charge to be allocated on the basis of administrative effort associated with particular bands, or in proportion to access prices paid, or on assessed value of frequency, or on some other basis? With diverse applications and users of spectrum, there is sure to be lively debate whatever allocative method is used.

Third, how unrestricted will use of licensed spectrum be? Will specified uses of bands (e.g. in accordance with international guidelines or conventions) be treated as indicative only, with the user free to determine use? If use is restricted, will an additional fee be payable on any subsequent relaxation of any restriction? Will administrative law remedies apply to SMA determinations as to use or other aspects of spectrum management?

Fourth, will 'banking' of frequency be restricted in any way? Despite Canberra's faith in the *Trade Practices Act* as a tool for regulating provision of services and facilities by corporations holding dominant market positions, the recent trend of 'essential facilities' style antitrust cases in the United States confirm the writer's pessimism as to the usefulness of general competition law to unblock bottleneck positions. The decision of the New Zealand Court of Appeal in relation to Telecom NZ's acquisition of the AMPS A frequencies indicates the difficulty that would face any claimant alleging that its competitors were 'bottling up' frequency as a competitive tool.

For example, consider the position of a spectrum licensee which refuses to sub-licence frequency to a prospective competitor either on the basis that it anticipates that the bandwidth will be required for further expansion of its own services or, having regard to developments in technology, it anticipates that a higher price may be derived from sub-licensing the bandwidth for other uses. These alternative uses may or may not be marketable at the time of the refusal to sub-licence — the spectrum licensee may anticipate technological developments increasing the development of relevant frequency bandwidth later in the period of its licence. The Federal Court in the 'Queensland Wire' case rejected the application of the 'essential facilities' doctrine in relation to cases involving communications. However, the High Court's decision in that case leaves open the argument that the licensee had substantial market power through controlling spectrum (subject, of course to any non-radiocoms alternatives) and had used that power to achieve the anti-competitive purpose of excluding market entry by a competitor.

Determination of whether the licensee had improperly exercised market power would require an evaluation of whether its motivation in refusing to sub-licence spectrum to the prospective sub-licensee was preventing competition withe the licensee in a market in which the licensee and the sub-license are or would be competitors. This would require a Court to develop a detailed understanding of the industry structure and the technologies associated with that industry. In any event, given the rapid pace of technological development and the start-up status of many prospective spectrum users, a prompt and cost effective means of resolving disputes over spectrum access would appear highly desirable. Unfortunately, resorting to the *Trade Practices Act* is neither cheap, quick nor predictable in outcome. An alternative would be to give the SMA a more substantial role in arbitrating or otherwise resolving spectrum access disputes, perhaps (but not necessarily) modelled on Austel's powers of direction.

Although a number of these questions may be answered in the legislation, there is little doubt that many will be left to the SMA to resolve or muddle through. The Government approach as outlined by the Minister appears relatively 'light handed' — more akin to the United Kingdom or New Zealand approach than to Australian telecommunications regulation. Although it is unfashionable to say so, the writer queries whether a 'light touch' will be enough, particularly given the possible strategic value of control of bandwidth as a competitive tool.

Peter Leonard is a partner with the Sydney technology law firm, Gilbert & Tobin, and specialises in telecommunications and information technology contracting and regulation. This column sets out his views and not those of clients of his firm.

Intelsat — Regulatory Relic or Global Competitor?

Irving Goldstein

Director General and CEO, International Telecommunications Satellite Organisation

Irving Goldstein was elected in December 1991 as Director General of Intelsat, the international cooperative of 124 member nations that owns and operates a global communications satellite system. Goldstein was formerly Chairman and Chief Executive Officer of the Communications Satellite Corporation (Comsat), the US company that is Intelsat's largest investor and user. He spoke with Liz Fell while in Sydney during November to attend the 18th Intelsat Assembly of Parties which was hosted by the Australian Government.

The formation of Intelsat has been described as a triumph of United States foreign policy. As the former head of Intelsat's largest user, would you agree with this?
Goldstein: That's not a bad expression, though I have a different personal perspective. Following Sputnik and the creation of NASA, when John Kennedy learned that the technology allowed communications satellites to be put into geosynchronous orbit along the lines of Arthur Clarke's original ideas, he could have decided either to make it an American thing or to make it worldwide. It is one of the few cases in my memory where the decision was not only correct, but it was done for the right reason: To share the technology and to make sure that developed as well as developing countries had the same opportunities to access high-quality satellite communications at reasonable cost.

Intelsat provided telecommunications amongst scores of countries well before there was even a US domestic satellite system. If that is a triumph of foreign policy, then I guess I would have to say that it was not exactly a charitable thing, because the United States has been one of the greatest beneficiaries of Intelsat, but not to the exclusion of other developed or developing countries. It was a brilliant decision in my mind.

AC: *Given the changes that have taken place during the 28 years since Intelsat was established, particularly the changes to telecommunications carriers that are signatories to the Intelsat Agreement, is it correct to say commercial interests are now paramount over foreign policy concerns?*
Goldstein: No, I wouldn't say that. Foreign policy interests have never been paramount. Intelsat is not a mini-UN. It is run as a commercial organisation, and always has been, and it is so stated in its charter. There is a give-and-take in the decisions made by the cooperative, and often countries take decisions that may not be in their own best interest. But they do it for the good of the Intelsat system and the comity of the relationships that exist among the signatories.

AC: *So what impact is the move towards carrier competition and commercialisation having on Intelsat?*
Goldstein: I would say it is because a small number of signatories have themselves become more commercialised and more privatised, that is causing changes in the organisation, though Intelsat for years was more commercial than many of the signatories.

It is important not to generalise on what Australia, Japan, Germany and the United Kingdom might be doing. We have 124 member countries or parties, to use Intelsat terminology, so we are talking about a handful. It is an important handful, and they are causing a lot of changes that will have longer term repercussions in the whole world of international telecoms. But it is not the case, which I sometimes hear, that 90% of our users are commercial and private.

AC: *Can we talk about potential competitors seeking to challenge Intelsat's dominant position in the international satellite market? For instance, Rene Anselmo, the founder of PamAmSat, is talking about creating a competitive global system.*
Goldstein: There has been some talk of PanAmSat creating a global competitive system. But they have only one satellite in orbit, and although they say they have contracts for several more, I don't know whether that is the case or not. Meanwhile, as we speak, Intelsat has 19 satellites in orbit, and we have ordered another ten, with more to come.

AC: *What is the situation with the former Soviet Union?*
Goldstein: Russia, Azerbaijan and Romania are members, Yugoslavia has been a member from the very beginning, and we should see almost all the CIS countries become members in the next year or so. In fact, at least one or two will probably become members in the next three or four months. But, more importantly, a large number own Intelsat earth stations and are our customers. They don't have to be members to use the system.

AC: *Do any of the CIS countries have plans to set up a competitive global system?*
Goldstein: They attempted to do that with Intersputnik which was not a great success from the point of view of the number of members using the system, other than the former Eastern European countries. From other points of view, it was a great success. But you are raising the question: Could another kind of global system emerge?

AC: *Yes. They are very smart with satellite technology.*
Goldstein: They are smart with the technology, and they are terrific at launch vehicles. Most of their satellites have been in highly inclined orbit, while most of ours have been station-kept. But I know that they can also build station-kept satellites. They are very good. What I hope they would do, and what I have seen them doing, is use the Intelsat system, which they do right now, and put their resources into launching rather than spend a lot of time worrying about setting up competing systems.

They have bid to Intelsat and others to launch satellites on the Proton vehicle. And they could help to build satellites that we might buy in the future rather than get into the business of providing services, which they're not going to be able to do in a reasonable way.

AC: *Surely that could trigger further controversy among the major US and European manufacturers? I'm thinking of the recent furor over Intelsat awarding its latest satellite contract to GE Astro-Space over Matra Marconi Space.*

Goldstein: You're right, except remember a couple of things. We have already contracted with Arianespace for launches. I was involved with that in the late 1970s when I represented Comsat on the Intelsat Board of Governors. Secondly, we signed our first contract earlier this year, with the export approval of the United States Government, to launch a satellite on China's Long March.

So the next step is a launch on Proton, which Inmarsat has announced. Russia is a very keen Inmarsat member. They are a member of ours too, but their level of traffic is not that high, therefore their ownership share is not as large, since investment share is a function of use of the system. So I think the Proton issue will take care of itself over time, and I don't see that as a major stumbling block with the US Government. I like the idea of competition and multiple launch providers.

AC: *That also raises the question of whether Intelsat and Inmarsat, the global mobile satellite operator, should be merged, as some have suggested. How do you see the evolution from small earth terminals such as VSATs to handhelds?*

Goldstein: I bet Iridium is the next question.

AC: *Yes, but the relationship between Intelsat and Inmarsat is interesting because they have the same owners.*

Goldstein: Let me come in from a different angle. As Comsat Chief Executive Officer and a major Inmarsat user, I made a controversial speech at Inmarsat's 10th Anniversary Conference where I said the boundaries between mobile and fixed services were disappearing, and soon it could be possible that almost everything would be mobile. I don't think my good friend, Olof Lundberg, [Director General of Inmarsat] liked it very much. Then when I ran for this position at Intelsat last year, and went around the world a couple of times campaigning, everybody said: 'What do you want to do? Do you want to merge the two organisations?' And my answer was: 'I have changed my mind. I don't see a short-term need or frankly much of a gain for the two organisations to merge. However, I will continue to keep an open mind on that possibility.'

I can make an argument for leaving them separate, and I can make an argument for putting them together. I think that we will have to wait and see what happens as to which way they will go.

AC: *And would Intelsat stand to lose traffic with low earth orbit mobile satellite systems such as Iridium?*

Goldstein: I don't really think so. I don't see it as in any way competitive because the capacity of a system like Iridium is not great enough to handle all the long-haul traffic: It has to come through other systems. Whether or not Iridium will ever turn into anything in five years, ten years, twenty years, I just don't know.

> *"Optical fibre . . . It is a fabulous technology. As a non-technical technology groupie, which I am, you cannot help but just say: 'It is unbelievable.' Is it changing our lives at Intelsat? Sure . . . But there will still be a need for satellites for several reasons. One is that no operator wants to put all its eggs in one technology basket . . ."*

AC: *In terms of commercial challenges, optical fibre cables must be capable of diverting more international traffic from Intelsat than competitive satellite systems?*

Goldstein: I don't see cables as competitive. I see them as complementary. I grew up in the cable and satellite world, and I saw no significant advances in cables for 20 years of my career. Optical fibre was the first truly significant boost to cable. It is a fabulous technology. As a non-technical technology groupie, which I am, you cannot help but just say: 'It is unbelievable.' Is it changing our lives at Intelsat? Sure. When we look out five or ten years, I see the bulk of the high density routes such as US-Western Europe or US-Australia-Japan-Hong Kong, and the vast bulk of the growth traffic, on optical fibre cables. But there will still be a need for satellites for several reasons. One is that no operator wants to put all its eggs in one technology basket if it can help it. And what about the medium density or low density routes? When are there going to be cables to the heart of Africa, for example?

AC: *Or the southwest Pacific?*

Goldstein: Sure, or the southwest Pacific, much of south America, much of Africa, and much of Asia. Users in these regions will continue to be major Intelsat customers. So there will be growth on Intelsat satellites, and I'm talking public switched voice service. But it will be small growth.

AC: *The Pacific has been a growth area for Intelsat for the last five or so years. Will that continue?*

Goldstein: Absolutely.

AC: *Even with the plethora of high capacity optical fibre cables linking Pacific Rim countries?*

Goldstein: There will be growth on satellites, smaller growth. Don't forget that all the video services, which are growing very fast, are on satellites.

AC: *But aren't video services a target market for regional and private international satellite operators? I'm thinking of the market targeted by Columbia/TRW, for instance?*

Goldstein: They may try, but I am not chary of competition. Anybody trying to get the traffic that we want to handle is going to have to get up pretty early in the morning and work hard. We are not going to give up anything to anybody.

AC: *When are you planning to fly the first Intelsat VII spacecraft in the Pacific Ocean Region? It was originally scheduled for mid-1992.*

Goldstein: The middle or third quarter of 1993 at the latest.

AC: *One signatory suggested to me early this year that the first Intelsat VII might be allocated to the Atlantic rather than the Pacific. Is that possible?*

Goldstein: I remember when I was first involved in Intelsat many years ago that the Pacific was referred to by some people from Australia, and from other countries too, as the 'garbage heap of the system.' That is no longer true.

AC: *But surely you would concede that the Pacific is not well-served by Intelsat right now? There has been a capacity shortage, and the satellites are mainly old and wobbly.*

Goldstein: I would make that much more general. We are not serving a lot of areas as well as we would like right now because the delivery of the Intelsat VIIs has been delayed. As a result, we have an enormous capacity shortage. We have a problem here in the Pacific, in South America and in East Asia. It is a difficult situation. One of my top objectives is to never let that happen again.

AC: *Why has this happened? Have signatories failed to accurately forecast customer needs at the Global Traffic Meetings or was it Intelsat management?*

Goldstein: All of the above. Nobody came anywhere close to forecasting the kind of incredible growth that would occur in international telecoms in the last three, four, five years. When I was at Comsat in the mid-1980s, we were constantly berated for being 'over-facilitised' by US Government and Congressional people who said: 'There are too many satellites coming along: You guys have to cut that out and stop that.' We didn't make the decisions.

AC: *Was that when Rene Anselmo and some other hopeful competitive US operators were* *pushing for permission to operate separate international satellite systems?*

Goldstein: Yes, but I didn't feel that was why that was happening. It was coming from the experts: The press and the technologists. Then a couple of years went by, and people said: 'Goodness, we're going to be short on capacity.' Fortunately and unfortunately, it works both ways. You can't go to the corner store and buy a bucket of satellite widgets overnight. It takes anywhere from one to two years to plan, and more time to issue and evaluate an RFP. Then you have to build, launch and test. The total process takes anywhere from five to seven or eight years. Fortunately, we are now in a situation where we can see the light at the end of the tunnel. We have a lot of satellites on order, and there will be more to come.

AC: *One of the controversial issues facing this Assembly and, indeed, the Assembly two years ago, was the relaxation of Article XIV(d) of the Agreement which requires signatories to consult with Intelsat on economic harm if they plan to use or operate competitive international satellite systems. What are the extremes of opinion on this? Are there some member countries that want to get rid of that, and others who want to keep it?*

Goldstein: I would say that the bulk of the parties are pretty much in accord that Intelsat will not, in the future, be able to hide behind Article XIV(d). Intelsat will not continue to survive and thrive for the next 28 years because of words written in a treaty document. Rather, it will continue to thrive because it will provide the needed and right communications services to its customers, many of whom are also its owners, but not all, at prices that they can afford to pay so they, in turn, can compete in the international market. That is the key to the future of Intelsat. The fact that the treaty is there has been a great help. It has enabled Intelsat to reach this stage. But as we look ahead, it is not a treaty that is going to act as a protection for Intelsat. Rather, it is the services, the capacity and the incredible interconnectivity that does not exist in any other system in the world.

AC: *Is it correct to say the Australian Government has been at the forefront in pushing for these changes?*

Goldstein: Yes, Australia has been one of the members pushing for Article XIX(d) not to continue to be the shield. The role of Australia and OTC in Intelsat has been important right from the very beginning with people such as Harold White, George Maltby, Randy Payne and Graham Gosewinckel playing an influential role in the development of the organisation. And, of course, Len Dooley from OTC is now Chairman of the Board of Governors.

AC: *And John Hampton, an Australian, ran against you for the Director General position last year?*

Goldstein: Yes, when I restructured the organisation, I created the position of Executive Vice President and that is filled by John Hampton. He is a terrific executive and a good friend and colleague. I could not do the job without him.

AC: *I understand Australia adopted a more extreme position on removing Article XIV(d) than was finally recommended by the Board. Is that correct?*

Goldstein: I would not be prepared to comment on that. We have a consensus that everybody can live with. This will stay in effect for a couple of years, then we will have to take the next step.

AC: *With increased competition, some commentators are predicting Intelsat will be forced to reduce its annual rate of return from 14%?*

Goldstein: Quite the contrary. We took a decision at the June meeting of the Board of Governors to lift it to 16% from January 1, 1993.

AC: *Do you foresee a need for Intelsat to seek equity from sources that are not Intelsat signatories?*

Goldstein: We have a situation already in some countries where competitors take service direct from Intelsat, and each makes a capital contribution. This is the case with AOTC and Optus in Australia. However, there can only be one signatory, and AOTC is the Australian signatory.

AC: *So no country has two signatories, is that correct?*

Goldstein: Strictly speaking, yes. In some countries, the signatory is a governmental entity, and in others it is one of the commercial entities. The good thing about the Intelsat Agreements is that they are flexible enough to allow any arrangement a Government wants.

AC: *What would happen if Intelsat were squeezed for funds?*

Goldstein: I cannot envision that happening just because of the way the organisation works. The capital contributions are made by the owners and customers in different countries based on the level of their investment share.

AC: *What is Intelsat's situation about external financing?*

Goldstein: Intelsat started that earlier this year when we floated a $US200 million Eurobond issue. We plan to move the debt capital ratio up to something like 30% over the period of six to seven years. That will reduce the need for the signatories to make additional capital contributions. We have an AAA rating.

AC: *That rating of Intelsat's is certainly better than some of the State Governments here in Australia.*

Goldstein: To be perfectly correct, Standard & Poor's gave us an AAA rating and Moody's gave us an AA+.

AC: *So into the future, you are obviously quite optimistic about Intelsat growing and changing?*

Goldstein: Yes, Intelsat's long-term Strategic Plan presented to this Assembly involves the steps we are going to take to make the organisation prosper, thrive and change.

AC: *Under the Strategic Plan developed several years ago, Intelsat adopted resource-based pricing principles. What does this pricing concept involve?*

Goldstein: You look at the cost of providing a certain amount of bandwidth and capacity, and then set the prices based on that. Intelsat had to become competitive and resource-based pricing has, and will continue to be, a great help.

AC: *What is the difference between resource-based and cost-based pricing?*

Goldstein: Not a whole lot.

AC: *Finally, in your former position as head of Comsat, why did Comsat express interest in Aussat and Australia's second carrier licence last year?*

Goldstein: Comsat took a hard look and decided not to proceed.

AC: *But Comsat was actually still there towards the end of the tendering process?*

Goldstein: Well, it was serious about taking a look.

AC: *Was it interested in becoming the second carrier in Australia?*

Goldstein: It was going to provide the technology and expertise for Aussat in conjunction with others who would have been the carrier.

Liz Fell is a freelance journalist and Senior Research Fellow at CIRCIT.

Tom Amos

Convergence — Paid Out

The vagaries of developing a Pay TV service in Australia were recently underlined by the inability of the Government to make a clear determination on how, when and where a new service will be introduced. The difference in the 1990's is that where once such one-way broadcasting licences were considered as licences to print monopoly money, things may have changed. Yet it seems the quiet new technology revolution and the emerging environment in telecommunications were all but ignored in choosing a hybrid mix of technology and software restrictions to create this new form of information delivery monopoly.

Some years back I was stunned by the then rapid developments in hardware technology that created the inexpensive solid state video display and camera. That was in the mid 1980's and today the technology has been so refined that the granular grey scale devices of only just a few years ago are now high quality colour units at a fraction of the price.

In the same period the ability to digitise and compress images also advanced but even more recently remarkable progress has been made, helped along by the computer processing revolution which has just kept on going. Algorithms for real-time compression are now at a stage where a single 64Kbps stream provides sufficient capacity for very acceptable simple image performance. Compression ratios of over 100:1 are now commonplace and where the technology will stop is really still a matter of conjecture. Store and forward delivery without the delay.

On the telecommunications carriage front (as opposed to the end user equipment) there has also been a change, not as rapid nor as widespread as in digital video equipment, but a change nevertheless towards the digitalisation of the old telephone transport system. The introduction of ISDN services and digital switches mirrored to some extent the computer power revolution in the customer premises equipment (CPE) area but as an overlay basis to the existing network rather than as a start again system.

The eventual marriage of all these technology changes started many years ago with videoconference-type services which were initially very expensive, both with the use of professional CPE components and wideband transmission charges. They started with full motion TV capacity and gradually, over a number of years, tracked the CPE developments down the digital path. The early pioneers took the arrows (as usual) in this field but the concept survived and today the special one-off video common rooms have gone, replaced by on premises dedicated equipment. Likewise, leased, dedicated bandwidth has been superseded by dial-up ISDN services. Where will it stop? The trend is very clear and it seems only the current deliberators have failed to have seen what is inevitable. AOTC is in fact already a new pseudo low-quality Pay TV operator, technology free or not.

The Pay TV debate, whilst enlightening in new and inventive ways that one can describe and disguise the pork barrel, has totally ignored that technology will make it almost impossible for 'black-market' Pay TV operators not to exist, even flourish. Modern digital telephone exchanges now offer as a standard service the ability to setup at will conference calls on a one-to-many basis. This facility replaces the old audio conference bridge and the tedious dial-up but more importantly, potential users can dial into a service much akin to either checking the time or a 0055 announcement.

The content of the information exchange is still free (but maybe I have just described a new 'content police'). Within local call areas there are to be no timed local calls for domestic users and the price and performance of both the codecs and the displays is still falling.

But the quality will not be anywhere near that of the new digital HDTV services that the Government is licensing I hear you say. True, but there is still a long way to go on the CPE front and the fundamental pipe I believe has sufficient capacity to deliver an acceptable service for a very low transmission fee.

The now humble videoconference technology is thus the potential root of a very serious problem for the development of Pay TV in Australia as it provides the clear integration path of the multimedia technologies. Coming from a different end is the computer based/optical CPE devices that have an insatiable software appetite. The transport is in place and with potentially open markets from 1997 the vertical niches are obvious. But why wait!

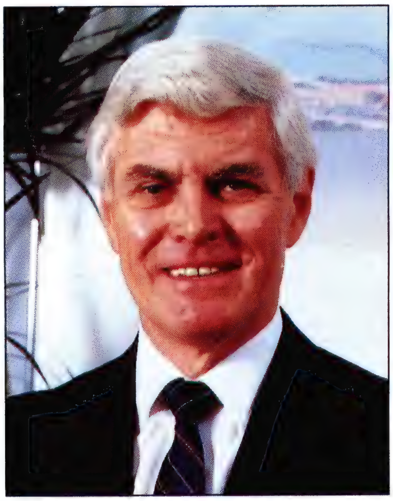
Bandwidth-based technologies tend to be going in the wrong direction when viewed in the light of what is occurring in the computing field. Broadcasting legislation also seems to be heading in the same wrong direction, driven not by the imperatives of the best at the most affordable price but by the apparent desire to optimise what is in the short term 'tin' rather than the higher ideals.

Pay TV was a great experience 30 years ago for a software deprived America, when the free to air system was not always available. The late twentieth century may be looked back upon as a time when a mature to declining idea of broadcast control was set in place without reference to the future.

Content and carriage are always key issues . . . the convergence of two-way and one-way service monopolies poses an interesting dilemma for the new marketplace. Broadcasting has a role in the mass dissemination of information and the ultimate weapon is to turn it off. Two-way services, where the recipient seeks the information or entertainment, are completely different in the manner they operate and also in the way in which they are effective in providing a service. The continued combination of carriage and content artificial monopolies is still difficult to understand although the sale of a taxing franchise is much more logical.

The common carriers stand to be at the forefront of the information age, yet content-like rules (via the sale of a software access franchise) prevent legitimate operation. Are we about to enter the TV licence issue in another form? The potential for a modern telecommunications-based media empire is definitely there and the technology could now easily out-distance the regulations.

Tom Amos is a partner with telecommunications consulting engineers Amos Aked Swift.



Bill Page-Hanify

Manufacturing — Now Dealing From Strength

The thesis of this paper is simple but it may surprise people. It is that when Australians are given the necessary resources, they are very good at manufacturing. During the last three years Alcatel Australia has established two new manufacturing facilities and seen revolutionary changes in others. As a result, I never cease to be impressed and delighted at the way Australians rise to the challenge of the extraordinarily competitive and complex world of manufacturing. Competitive, because the world is awash with excess capacity in practically every manufacturing industry and ours is no exception. Complex, because today it needs the interaction and teamwork of an extensive range of specialists.

In addition, the manufacturer is frequently ahead of the training institutes. One example of this was at our world class export operation for making optical submarine cables at Port Botany. The massive computer management system for the factory monitors over 2,000 individual parameters as the cable takes shape. A key part of the management system is PLC (Process Logic Controlled Technology) and we found we had to establish our own training courses because the educators had not yet started providing courses in it.

This cable plant epitomises the *new* Australian manufacturer. It operates round the clock, seven days a week. At the first sign of trouble, the line operators work with the maintenance engineers to rectify the problem. The three guiding rules are *quality*, *quality* and *quality* — which of course includes the quality of responsiveness to the customers. And the fourth rule is *continuous improvement* of every process which in turn has enabled us to produce at record levels for the PacRim and SeaMeWe cables.

Remembering my caveat above about 'given the necessary resources,' the submarine cable system operation required an investment of $120 million and the training (much of it overseas) of nearly 100 personnel who brought the cable and opto-electronic technologies back to Australia. Very few of the people had any previous submarine cable industry experience but now they can match it with the best.

Another major investment has been our $45 million high technology system facility at Liverpool which is now producing the Alcatel 1000 S12 switching system and the Alcatel MAN broadband system. Soon other advanced products will be added. This facility has its own computerised core for software development and manufacturing support. Indeed, it is an integrated R&D and manufacturing operation, with the development engineers at their workstations alongside the industrial engineers.

Those who talk about 'nimble fingered workers somewhere else making black boxes' could usefully spend a period studying the complex processes (both physical and intellectual) and their associated TQM measures that combine to produce leading-edge systems. It takes more than nimble fingers to get the best out of an integrated surface mount line, to devise the test and configuration programmes for the systems, to analyse and correct failures and develop new hardware/software systems such as the Remote Integrated Multiplexer (RIM).

Parallel and integrated development of product and manufacturing processes — something that can only be achieved in close proximity to the factory environment — ensure optimum designs and minimum 'time to market' realisation. Without this, the ever decreasing product life cycles of our industry would condemn us to being late in the market and would seriously reduce our possibilities for success. These are the competitive strengths which we can utilise.

Something we seem to have rediscovered only recently is that when it comes to teamwork, Australians excel, and modern manufacturing is increasingly a team effort. Not only are all your traditional project managers, design engineers, field support engineers, industrial engineers and material functions involved. All the services of the company, including Marketing, Information Systems, Financial and Personnel, work as integral parts of the modern manufacturing team.

I've mentioned the newest and latest in our manufacturing armory, but more traditional CPE products get constant improvement attention too and the streamlined phone and Small Business Systems manufacturing teams (multi-skilling predominates) bear little resemblance to the past.

Most importantly though, all these activities create real wealth for Australia, something which would be impossible without the manufacturing elements and they combine together to give us a broad spectrum export capability which is only matched by relatively few countries overseas. In fact we are singularly well placed here in the Asia-Pacific region to keep capitalising on domestic and export successes as we serve a rapidly growing market which is conveniently largely in our own time zones.

Australia has had few heroes over the last decade or so.

True, we've made many attempts to find them. First it was the entrepreneurs that were going out to conquer the world and then lost our shirts on our behalf. Then it was the service industries, led by the deregulated banks (sic) who were going to get our shirts back but who almost managed to make the entrepreneurs look good. Other industries were identified in turn but faltered for various reasons.

The one industry that has been plugging along throughout the period has been the frequently reviled manufacturing sector until with some surprise it was realised that manufactured exports now exceed primary products for the first time in our history. Alcatel's exports from Australia this year will be worth about $200 million or around 30% of sales and we can see this increasing in the future.

Australians are showing their skills as manufacturers in the most positive and emphatic fashion. It is the resurgence in manufactured exports (and import substitution) that offers the only real hope of closing our balance of payments gap. If we keep up the the present momentum (which means maintaining and strengthening existing policies), then we'll once more be back on track towards increasing prosperity.

Bill Page-Hanify is the Chairman and Managing Director of Alcatel Australia Ltd.

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AusComms Buys a Data Network

How can you compare WAN solutions from different networking specialists? Brian White examines the responses of nine vendors to the same set of wide area network requirements.

We've done it again. Twelve months ago Australian Communications published its landmark 'AusComms Buys a Wide Area Network' article comparing in detail the offerings of six wide area network vendors based on the requirements of a fictitious company (AusComms Pty Ltd). Such was the great interest generated by that article that we've decided to repeat the exercise in an even bigger and better fashion. AusComms now has a new set of requirements and this year solutions from nine networking vendors — 3Com, Ascom Timeplex, Bull, Com Tech Communications, Interlink Communications, NetComm, Retix, Sun Microsystems and Ungermann-Bass — have been selected for comparison.

Unlike last year's exercise, AusComm's requirements (as outlined in a Request For Information supplied to the vendors) are now purely data oriented and focus on the interworking of different environments: Novell, TCP/IP, SNA, DECnet and LocalTalk. With the trend toward multiprotocol networking and the integration of LANs into the enterprise network, our goal has been to try and represent as many real-life problems and issues now faced by network managers.

What follows is Part I of our two-part analysis of the solutions put forward by the nine vendors. This first installment will give an overview of the responses, explain each vendor's approach and identify the main differences between the approaches. Part II, which will appear in next month's issue, will take a more detailed look at each solution and pay particular attention to technical issues. But before reading on a word of caution: This analysis is intended more as a starting point than a complete guide to networking solutions; WAN design issues are simply too numerous and complex (and in many cases unique to the prospective buyer) to be satisfactorily explored in a single article.

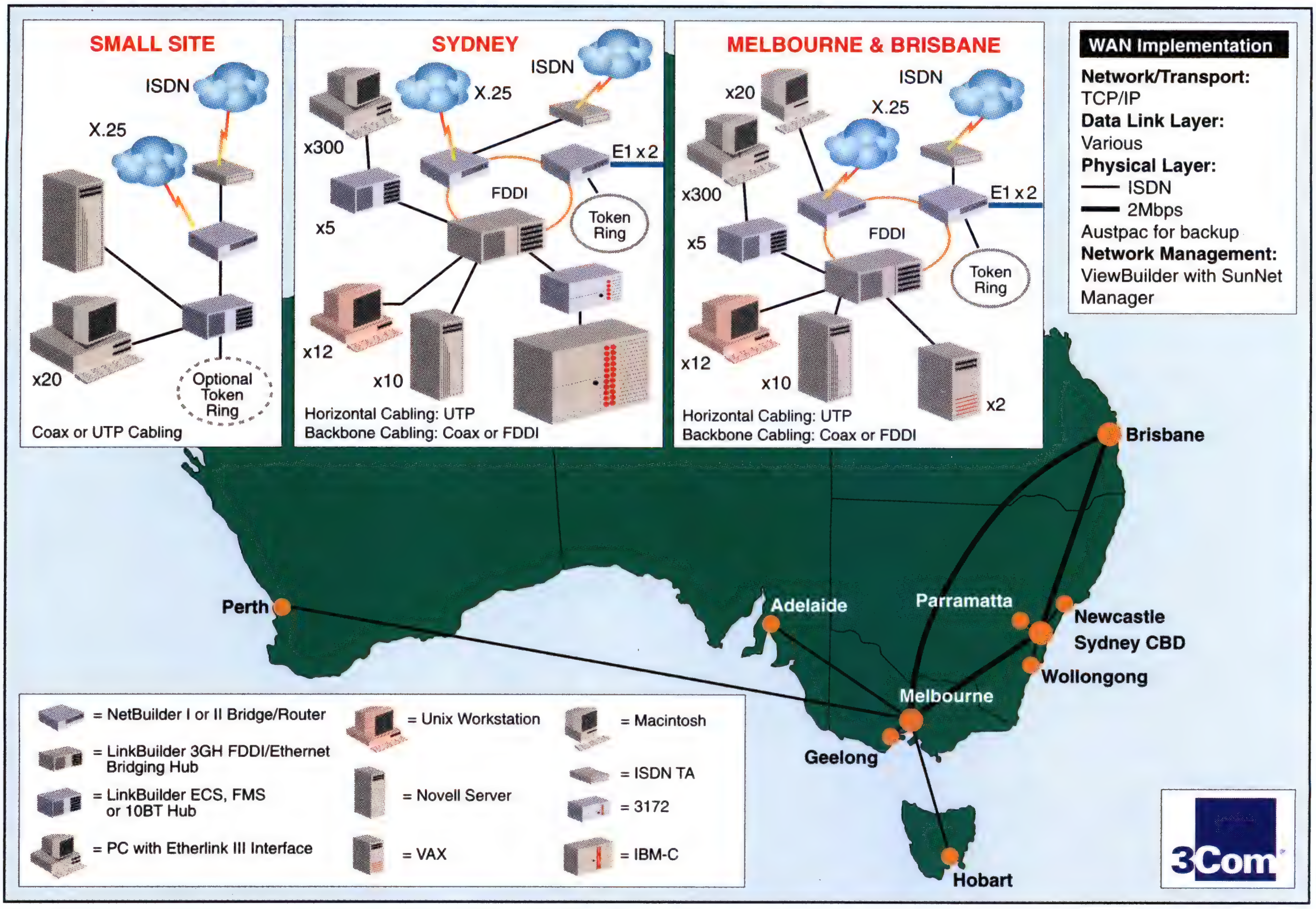
AusComms Pty Ltd is headquartered in Sydney, has major sites in Melbourne and Brisbane and seven minor sites at Parramatta, Newcastle, Wollongong, Geelong, Adelaide, Perth and Hobart. Each site maintains standalone computer hardware and local area networks of varying degrees of size and sophistication but the company does not have in place inter-site network links.

Each of the major sites (Sydney, Melbourne and Brisbane) has 300 DOS-based PCs, 8 printers, 12 Unix workstations and 10 Novell 3.11 file servers, spread over six floors. Each of the small sites is configured with 20 PCs, a printer and a Novell 3.11 server on one floor. In addition, the three major sites in the proposed AusComms network have special network requirements: Sydney — IBM compatible mainframe; Brisbane — 2 VAXes and a 20 user AppleTalk LAN; and Melbourne — 2 VAXes and a 20 user AppleTalk LAN.

In summary, AusComms currently has the following equipment:

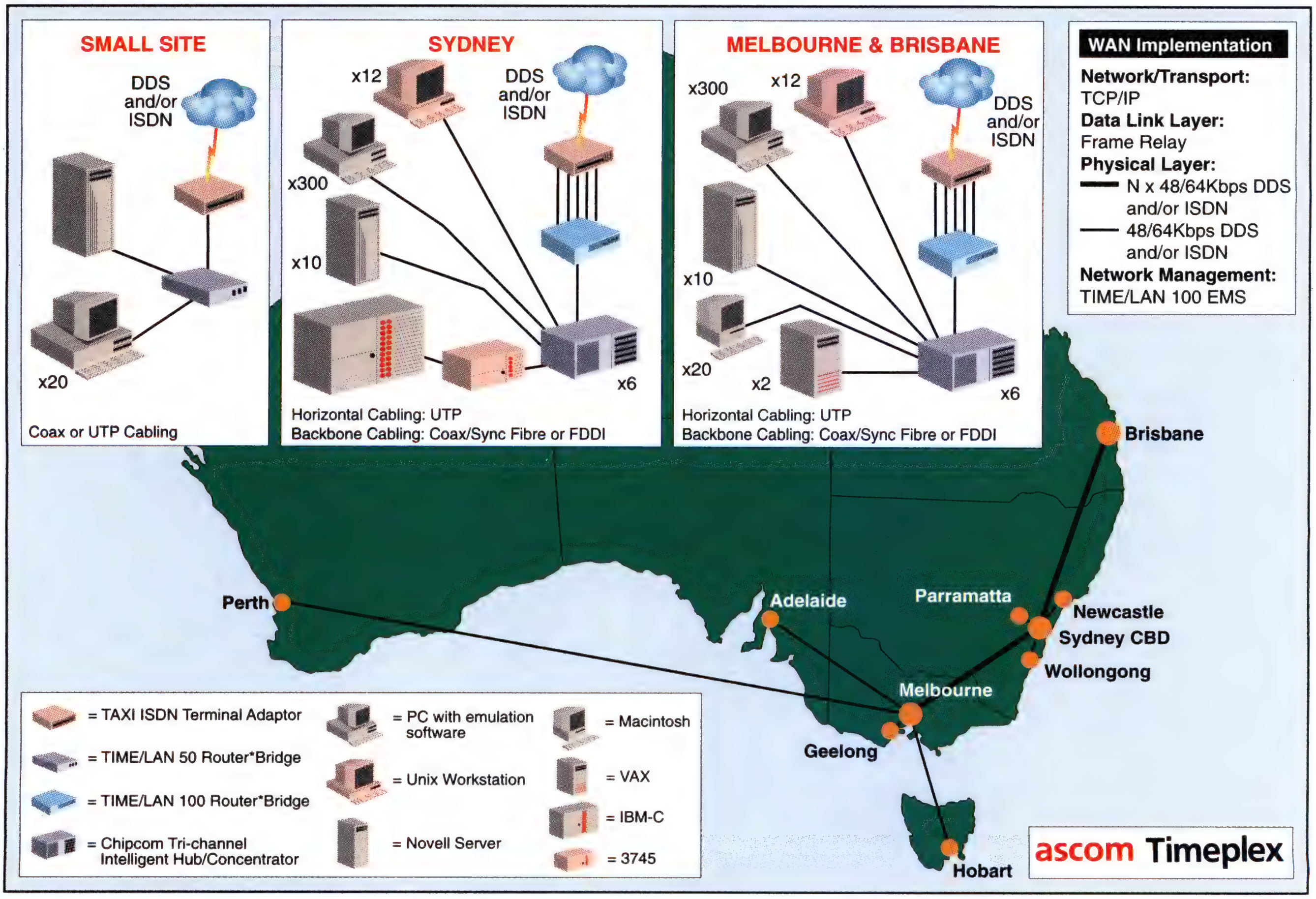
- 40 Apple Macintoshes connected with AppleTalk;
- An IBM compatible mainframe;
- 4 DEC VAXes using DECnet phase IV;
- 36 workstations with Unix and TCP/IP; and
- Over 1,000 DOS PCs using 37 Novell (3.11) file servers.

In its Request For Information (RFI) circulated to prospective wide area network suppliers, the company revealed its plan to embark on



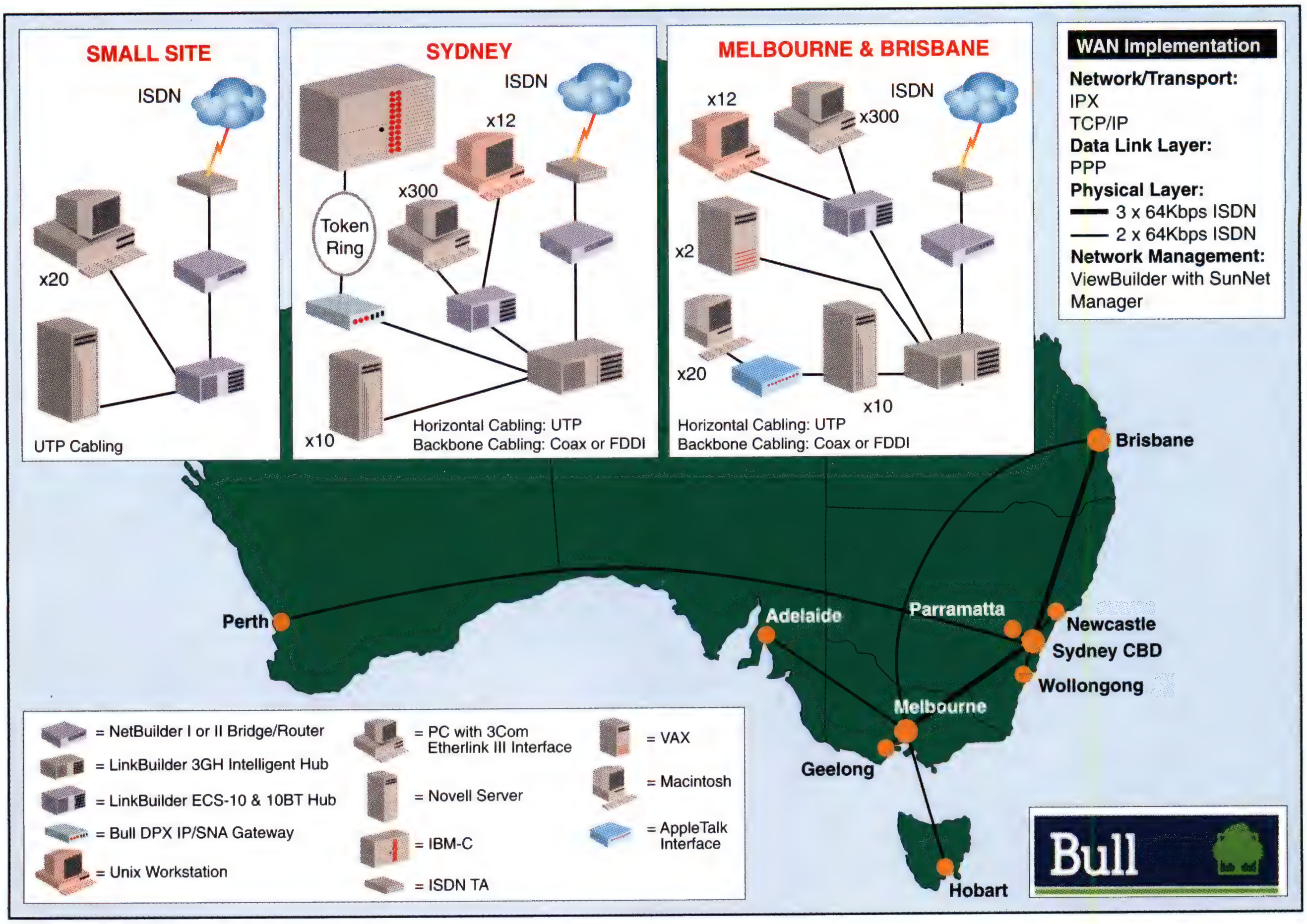
WAN Implementation

Network/Transport:
TCP/IP
Data Link Layer:
Various
Physical Layer:
— ISDN
▬ 2Mbps
Austpac for backup
Network Management:
ViewBuilder with SunNet Manager



WAN Implementation

Network/Transport:
TCP/IP
Data Link Layer:
Frame Relay
Physical Layer:
▬ N x 48/64Kbps DDS and/or ISDN
— 48/64Kbps DDS and/or ISDN
Network Management:
TIME/LAN 100 EMS



a significant upgrade of its computer resources which would replace the small number of existing standalone computers and dumb terminals with a new network of PCs, Unix workstations and Apple Macintoshes accessing a wide range of resources including the Sydney-based IBM compatible mainframe and DEC VAXes located in Melbourne and Brisbane.

As outlined in the RFI, the essential functional requirements were:

a) Terminal sessions;
b) File transfers;
c) Remote file access; and
d) Application interoperability

between any user and any host computer.

To assist vendors, the following assumptions were offered:

- All WAN traffic is either between large sites or between large/small sites (i.e. no traffic small site to small site);
- The three large sites have equal traffic between each other; and
- The traffic from each small site is equally shared between the large sites.

3Com

3Com designs, manufactures and markets a wide range of multi-vendor data connectivity products. Founded in 1979 by one of the inventors of Ethernet, 3Com is the leading supplier of Ethernet network interface cards. The company's corporate strategy is to provide standards-based data networking solutions to support increasingly larger internetworks, combined with simplified installation, operation and management.

3Com's solution to the RFI requirements uses TCP/IP as the dominant protocol. The VAXes would connect to each other using DECnet IV (routed by NetBuilder bridge/

The AusComms Request For Information

Because AusComms Pty Ltd issued a Request For Information (RFI) rather than a Request For Tender (RFT), there was no requirement for responding vendors to address issues such as:

- Product pricing;
- Maintenance and support services; and
- Commercial terms and conditions.

A three-part document (Introduction, Requirements, Questions to Vendors and Schedules), the RFI instead asked vendors to recommend solutions to meet the requirements of AusComms in terms of network products and an appropriate network design. The scope included:

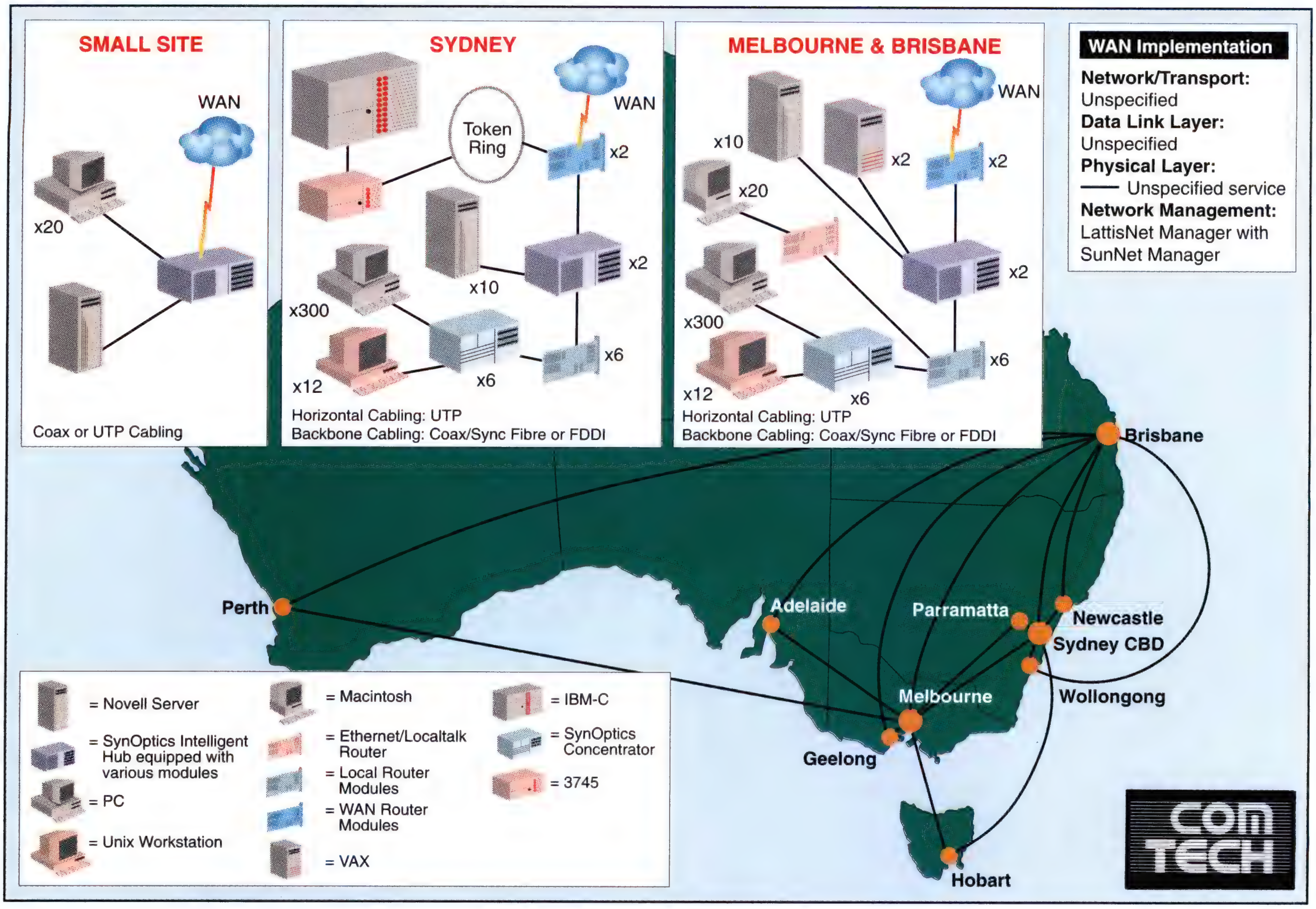
- WAN access (e.g., multiplexing);
- Networking (bridging/routing);
- Personal computer access (hubs, software, add-in cards etc.);
- Host system access (interface devices, software, etc.);
- Tools (e.g. network management system); and
- Recommended wide area network design (e.g. carrier link services).

In particular, the document specifically stated that to implement the new network existing dumb terminals would be replaced with intelligent workstations, PCs and Apple Macs.

An example of the scope given to vendors was the front-end processor for the IBM-compatible mainframe, which was specified as a 3720. This is a largely obsolete product (superseded by the 3725 then 3745) and was specified to allow vendors to recommend either a traditional 3745 or a more radical alternative of a 3172 LAN Interconnect Controller.

The RFI was also written in a way which constrained the vendors as little as possible, so that they could recommend things such as appropriate cabling systems and specific hardware/software host interfaces to allow their solutions to match AusComms' requirements. The document also allowed respondents, where necessary, to suggest either generic products or specific products from third parties.

Brian White



routers) but would also have TCP/IP to allow Telnet and FTP access for the DOS, Unix and Mac clients which would provide terminal sessions and file transfers respectively. Telnet would be better than the non-routable LAT protocol and would be more tolerant of WAN congestion.

3Com suggests that the mainframe could also run TCP/IP, without the need for cluster controllers and a front-end processor. This would use an IBM 3172 and Token Ring into the Sydney backbone. The less desirable alternative suggested by 3Com would be to use SDLC and LLC 2 bridging or IP encapsulation if there was a need for SNA.

The hardware used is the LinkBuilder hub/concentrator and the NetBuilder bridge/router connected with UTP and FDDI; the larger, RISC-based NetBuilder II at large sites and the smaller NetBuilder at small sites. Large sites have a LinkBuilder 3GH third generation intelligent hub which connects to five LinkBuilder ECS 48-port concentrators. The 10 Novell file servers are connected directly to the 3GH hub. The NetBuilder IIs would interface the hub to the wide area network and would also serve as a gateway between the hub and the AppleTalk local area network.

The network design is a standard tree topology with a 2Mbps (Megalink) loop between the large sites. Telecom ISDN services are suggested for small sites with public X.25 (Austpac) as a backup.

Ascom Timeplex

Ascom Timeplex has over 22 years of experience in the areas of data and voice networking. The original Timeplex company was taken over by Unisys, but was later sold to Ascom to become Ascom Timeplex.

The approach Ascom Timeplex has taken is to use TIME/LAN Router*Bridges to connect the smaller regional offices to the three main locations. TIME/LAN uses frame relay over WAN links for faster throughput. Chipcom Online concentrators are offered for local connectivity. Ascom Timeplex also offers its own TAXI ISDN terminal adaptor to provide switched network backup or overflow bandwidth.

The dominant elements of the solution are TCP/IP and an Ethernet backbone. The TIME/LAN 100 brouter is used at the larger sites and the smaller TIME/LAN 50 brouter is used at the regional sites. The TIME/LAN can be fitted with a combination of LAN and WAN interfaces. 10Base-T is recommended at both large and small sites, with either a coax or FDDI backbone at large sites, depending on traffic. Mainframe connectivity is via the brouter to the 3745 FEP. DECnet IV is also routed by the TIME/LAN brouters. LAN Workplace (or other TCP/IP alternatives) would be used on the PCs and the Macs for terminal emulation and file transfer.

The network design has a tree topology and Digital Data Service (DDS) network services at either 48Kbps or multiples of 48Kbps between major sites.

Bull HN

Bull HN Information Systems Australia is a subsidiary of the US-based Bull HN Incorporated. Bull HN, together with Zenith Data Systems and Bull SA comprise the Paris-based conglomerate known as Groupe Bull. Groupe Bull is a full information technology supplier with a vision to be a major player in the provision of complex network solutions, network services and integrated business solutions.

The approach Bull has taken is to utilise the 3Com product range for hubbing, wide area and local area connectivity. The dominant protocols are TCP/IP and IPX, with PPP (Point-to-Point Protocol) used for more efficient carriage of TCP/IP over the WAN. 3Com NetBuilder bridge/routers are used in their routing configuration to provide greater functionality for the protocols supported.

In the large sites, an intelligent hub is used (3Com's 3GH) as the network core. This connects through NetBuilder routers to the WAN. In the case of Sydney, connections are made via a Bull DPX SNA gateway to the mainframe's local Token Ring. DEC VAXes connect directly to the intelligent hub. 3Com LinkBuilder cabling concentrators are used to aggregate the 10Base-T cabling back to the intelligent hub.

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S Robert Levine
President & CEO

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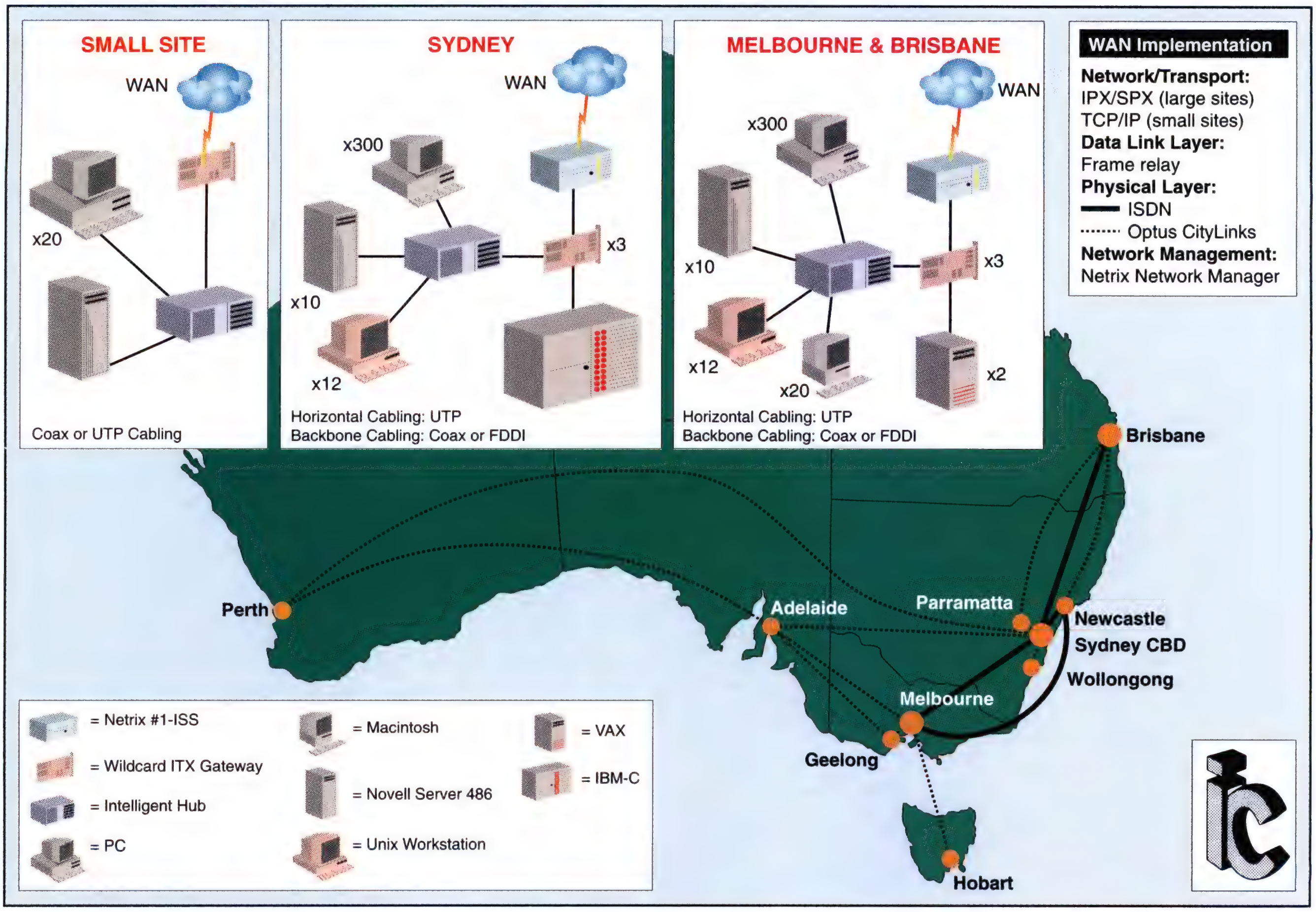
SMALL SITE
WAN
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Coax or UTP Cabling
SYDNEY
WAN
x300
x3
x10
x12
Horizontal Cabling: UTP
Backbone Cabling: Coax or FDDI
MELBOURNE & BRISBANE
WAN
x300
x3
x10
x12
x20
x2
Horizontal Cabling: UTP
Backbone Cabling: Coax or FDDI
WAN Implementation
Network/Transport:
IPX/SPX (large sites)
TCP/IP (small sites)
Data Link Layer:
Frame relay
Physical Layer:
ISDN
Optus CityLinks
Network Management:
Netrix Network Manager
Brisbane
Perth
Adelaide
Parramatta
Newcastle
Sydney CBD
Wollongong
Melbourne
Geelong
Hobart
= Netrix #1-ISS
= Wildcard ITX Gateway
= Intelligent Hub
= PC
= Macintosh
= Novell Server 486
= Unix Workstation
= VAX
= IBM-C
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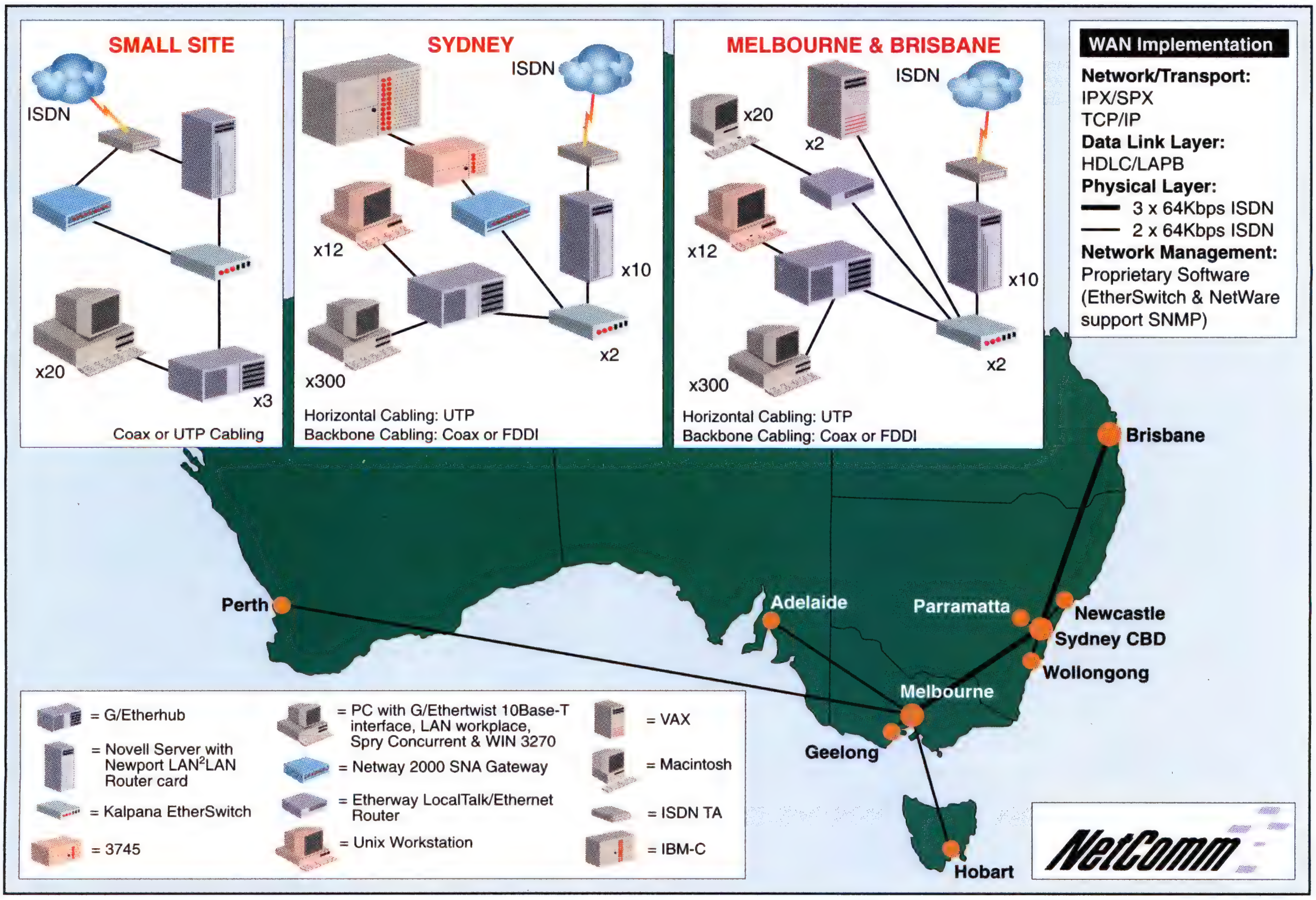
SMALL SITE
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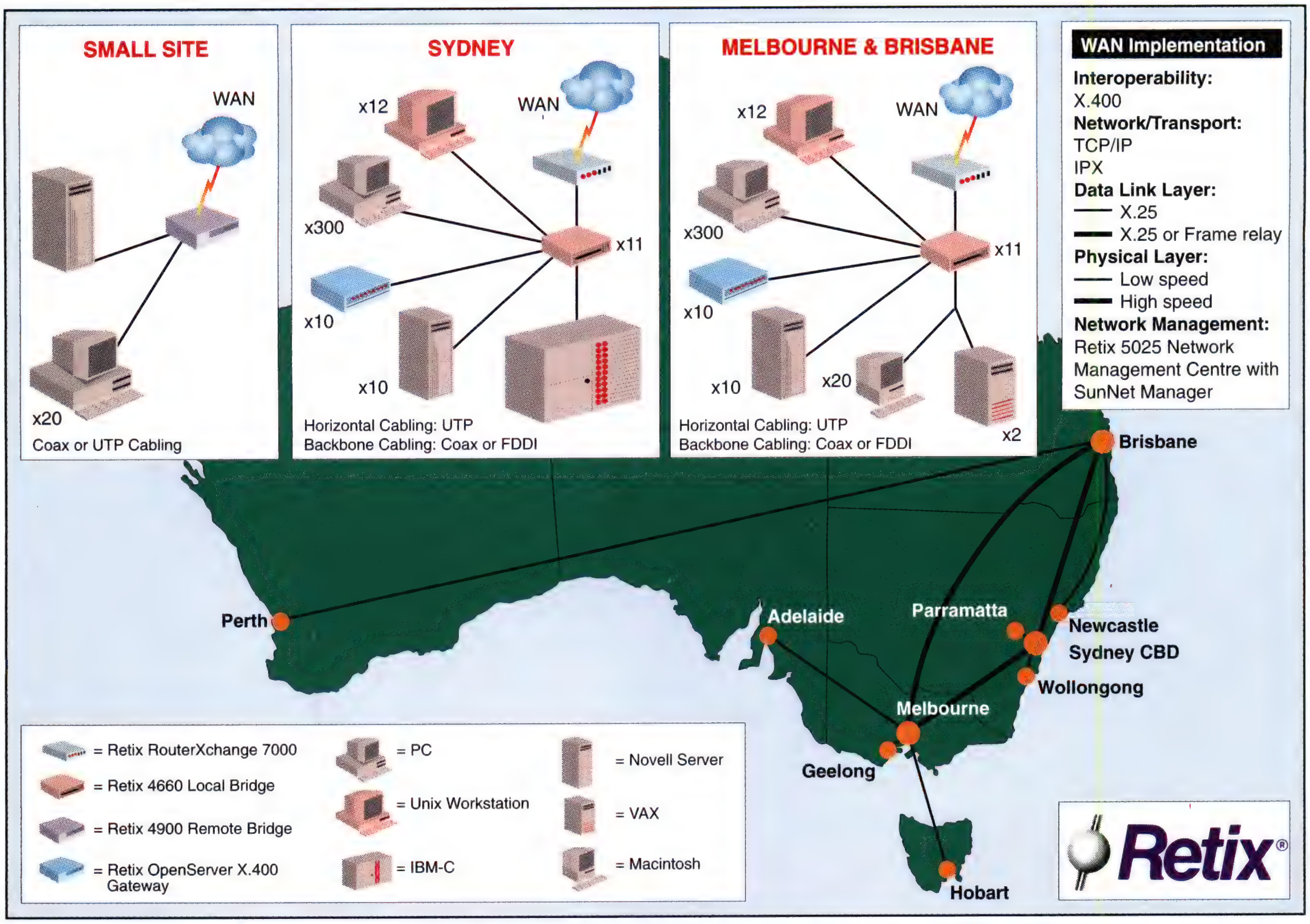
Horizontal Cabling: UTP
Backbone Cabling: Coax or FDDI
MELBOURNE & BRISBANE
ISDN
x20
x2
x12
x10
x300
x2
Horizontal Cabling: UTP
Backbone Cabling: Coax or FDDI
WAN Implementation
Network/Transport:
IPX/SPX
TCP/IP
Data Link Layer:
HDLC/LAPB
Physical Layer:
3 x 64Kbps ISDN
2 x 64Kbps ISDN
Network Management:
Proprietary Software
(EtherSwitch & NetWare
support SNMP)
Brisbane
Perth
Adelaide
Parramatta
Newcastle
Sydney CBD
Wollongong
Melbourne
Geelong
Hobart
= G/Etherhub
= Novell Server with Newport LAN^{2}LAN Router card
= Kalpana EtherSwitch
= 3745
= PC with G/Ethertwist 10Base-T interface, LAN workplace, Spry Concurrent & WIN 3270
= Netway 2000 SNA Gateway
= Etherway LocalTalk/Ethernet Router
= Unix Workstation
= VAX
= Macintosh
= ISDN TA
= IBM-C
NetComm



In small sites, LinkBuilder concentrators connect to all the local devices again using 10Base-T. The LinkBuilder connects to the WAN through a NetBuilder router. Macintoshes are supported via AppleTalk interfaces and the Novell servers. Bull HN's network design uses a tree topology with multiple ISDN B-channel services connecting sites.

Com Tech

Com Tech was established in Sydney in 1987 to offer a specialist networking distribution service and now operates five divisions (networking, Unix, cabling, office automation and training) throughout Australia. Its business philosophy is to become a one stop source of supply for all local and wide area data networking products and Unix solutions. Com Tech is a distributor rather than a vendor. This gives it a deeper understanding of its products, as it serves as high level technical support to vendors and also runs technical training courses for all its products. Half of Com Tech's staff are engaged in technical support activities.

Com Tech's approach to the AusComms RFI is to use an intelligent hub solution to provide both LAN and WAN functionality in one integrated system. The equipment used in the Com Tech solution uses a number of the many options within the SynOptics LattisNet product range. The LattisNet product line includes local connectivity for Ethernet, Token Ring, FDDI and asynchronous communications. WAN functions supported include both bridging and routing.

The network design uses a mesh topology. The three main sites have either six or seven links each whereas the small sites are each connected to two of the large sites. This approach provides a high degree of capacity and reliability through redundancy. The type of data services used to connect the WAN are not specified, nor are the bandwidths of the services. The LAN solution in each of the large sites uses a large three shelf hub in the computer room connected using an FDDI backbone to a concentrator on each of the six floors. The PCs and the Unix workstations are connected using twisted pair Ethernet to the six floor concentrators, each equipped with a local router.

The computer room hub is connected directly over FDDI to the 10 Novell servers, the VAXes (Brisbane and Melbourne) and two WAN routers. The WAN routers then connect through dual Token Rings to the IBM compatible 3745 FEP in Sydney. The Macs connect to one of the floor concentrators through an AppleTalk router.

Interlink

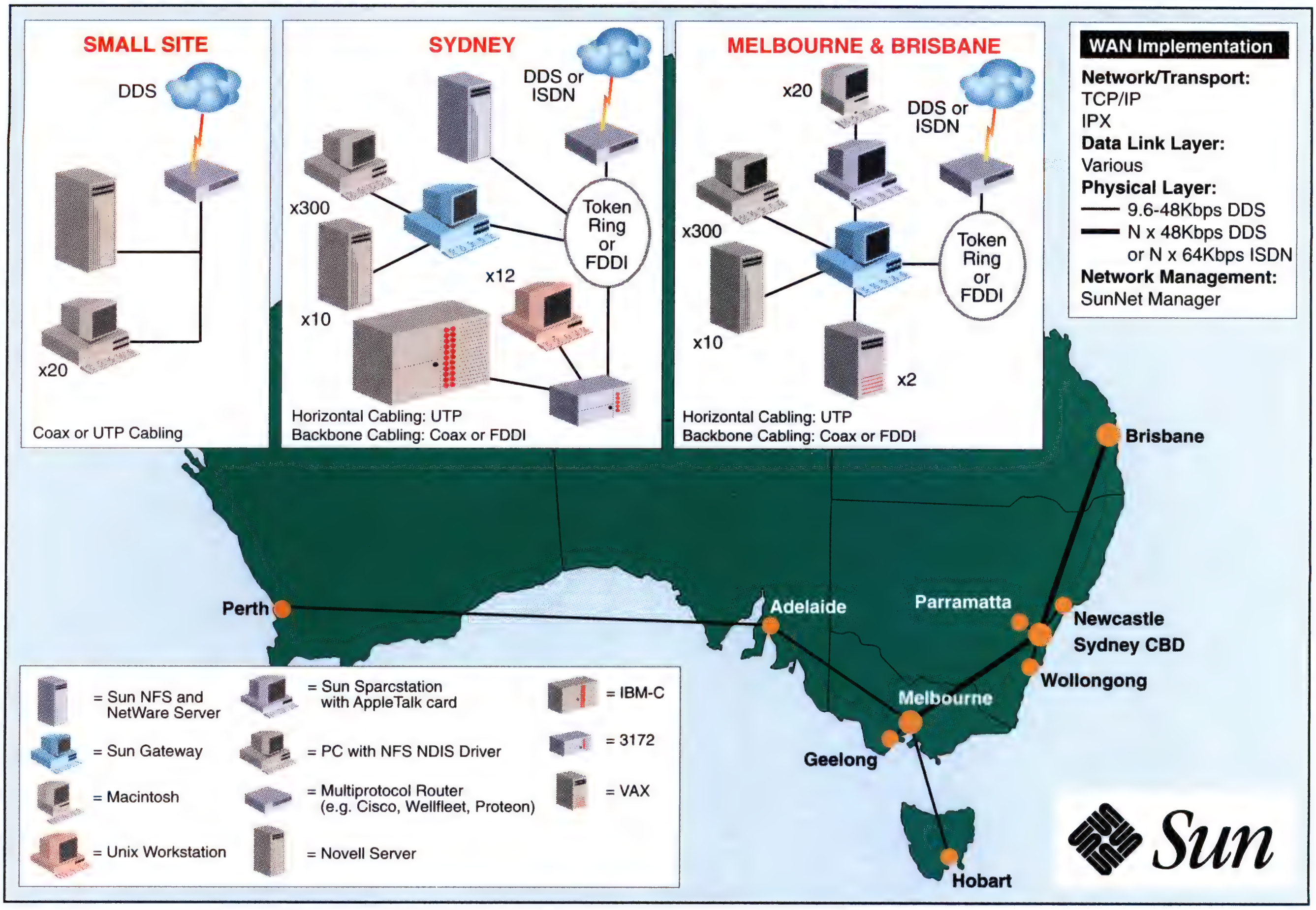
Interlink Communications is an Australian company which was founded in 1984 and specialises in OSI and X.25 data networking products. Interlink markets and supports products from Netrix, Dynatech, TIL and Advance Compression. Interlink's business philosophy is to bring the most advanced and effective data networking solutions to the Australian marketplace.

Interlink's approach to AusComm's requirements is based on the Netrix #1-ISS (Integrated Switching System) switch to form the basis of the WAN and the Datahouse Wildcard ITX to support terminal emulation and protocol conversion. The Netrix #1-ISS is a fully redundant backbone class switch which uses a mixture of circuit/packet/frame relay transmission, with dynamic allocation of bandwidth according to traffic requirements.

The Datahouse Wildcard ITX is proposed to provide 3270 SDLC to Telnet conversion, async to 3270 SDLC conversion, PU concentration, SNMP-based management and security features.

The Novell servers run the TCP/IP NetWare Loadable Module (NLM) to gain access to the TCP/IP WAN backbone. VAXes would use TES (Terminal Emulation Service) which is part of NetWare for VMS running over IPX. Both the PCs and Macintoshes run LAN Workplace so that they can access the TCP/IP servers and Novell servers respectively.

Interlink's modelling of the AusComms network results in a design which uses multiple paths between locations. The services suggested to minimise the bandwidth re-



quirement are a mixture of ISDN and Optus Citylinks although link speeds are not specified. Traffic between locations would use frame relay for efficient transmission of IPX and TCP/IP. Frame relay is supported both by the Netrix #1-ISS and the Wildcard ITX.

At small sites, an intelligent hub would connect through a Wildcard ITX to the WAN. A similar arrangement applies at large sites except that the Netrix #1-ISS would interface to the WAN, to manage WAN transmission between the three major locations. Structured cabling is suggested using a mixture of UTP and optical fibre media and an unspecified intelligent hub.

NetComm

NetComm is an Australian-owned company which commenced in 1982 by designing and manufacturing an SDLC adaptor card for an Apple II. NetComm now employs over 130 staff and is a specialist in developing high performance modems. NetComm markets a wide range of data communications products including network operating systems and network devices as well as a wide range of modem and facsimile card products.

The products relevant to the AusComms Request For Information include: Novell NetWare, Gateway Ethernet cards, Thomas Conrad Token Ring cards, Farallon Ethernet adaptors for Macintosh, LAN^{2}LAN multiprotocol routers, the Kalpana EtherSwitch, the Netway SNA gateway and the Transway LocalTalk router.

NetComm's approach to the RFI is to use the NetWare servers as the platform for connectivity for all DOS, Unix and Macintosh machines to VAXes and the IBM compatible mainframe. Each NetWare server at small sites includes a Newport LAN^{2}LAN router card and appropriate NLMs for connectivity to VAXes and Unix workstations.

Each PC uses LAN Workplace for DOS and SPRY Concurrent to give simultaneous access to NFS and NetWare. A similar approach is used at the large sites. An AppleTalk NLM gives DOS workstations access to AppleTalk printers and Mac access to NetWare resources.

A Netway 2000 SNA gateway is located in every site to connect to the IBM compatible mainframe. The mainframe's 3745 connects over a separate ISDN link to each of these remote gateways. Terminal emulation is achieved using Avatar's Win3270 on PCs and Mac Netway 3270 for Macintoshes.

The Network design implements a low cost, tree topology using ISDN services. Major links use three B-channels whereas other links use two B-channels. The hubbing scheme uses Gateway 10Base-T Etherhubs connected in a star fashion to a Kalpana EtherSwitch in each site. The EtherSwitch switches Ethernet traffic for up to seven simultaneous pairs of Ethernet segments, using the learning algorithm.

Retix

Retix aims to be a leader in data network protocol technology and markets a number of 'open-networking' products including bridges, routers and messaging software. The company has provided a solution to the AusComms RFI which uses its high performance RX-7000 Router Exchange coupled with 4660 local bridges in the three large sites. Small sites use its 4942 bridge/router to interface to the WAN.

The RX-7000 is planned to have SNA connectivity at a future date, but an alternative such as using TCP/IP on the IBM compatible mainframe is not detailed. All Retix products support DECnet IV and LAT for terminal session, file transfer and inter-host DEC VAX connectivity.

A significant feature of the Retix solution is its OpenServer 400 software range, which runs on DOS, OS/2 and Unix to allow users and applications to exchange messages with other systems supporting X.400 via X.25 or 802.3 (Ethernet). OpenServer 400 uses a file server such as a NetWare server for message store and forward. This allows PC mail systems such as cc:Mail to exchange messages with DEC's All-In-One or IBM's PROFS. The Unix version of OpenServer is also offered to provide similar messaging facilities for the Unix workstations.

The network design uses a tree topology with a high bandwidth triangle between the

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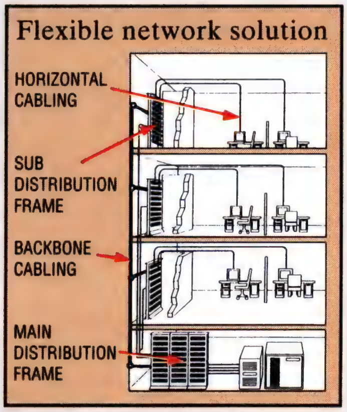

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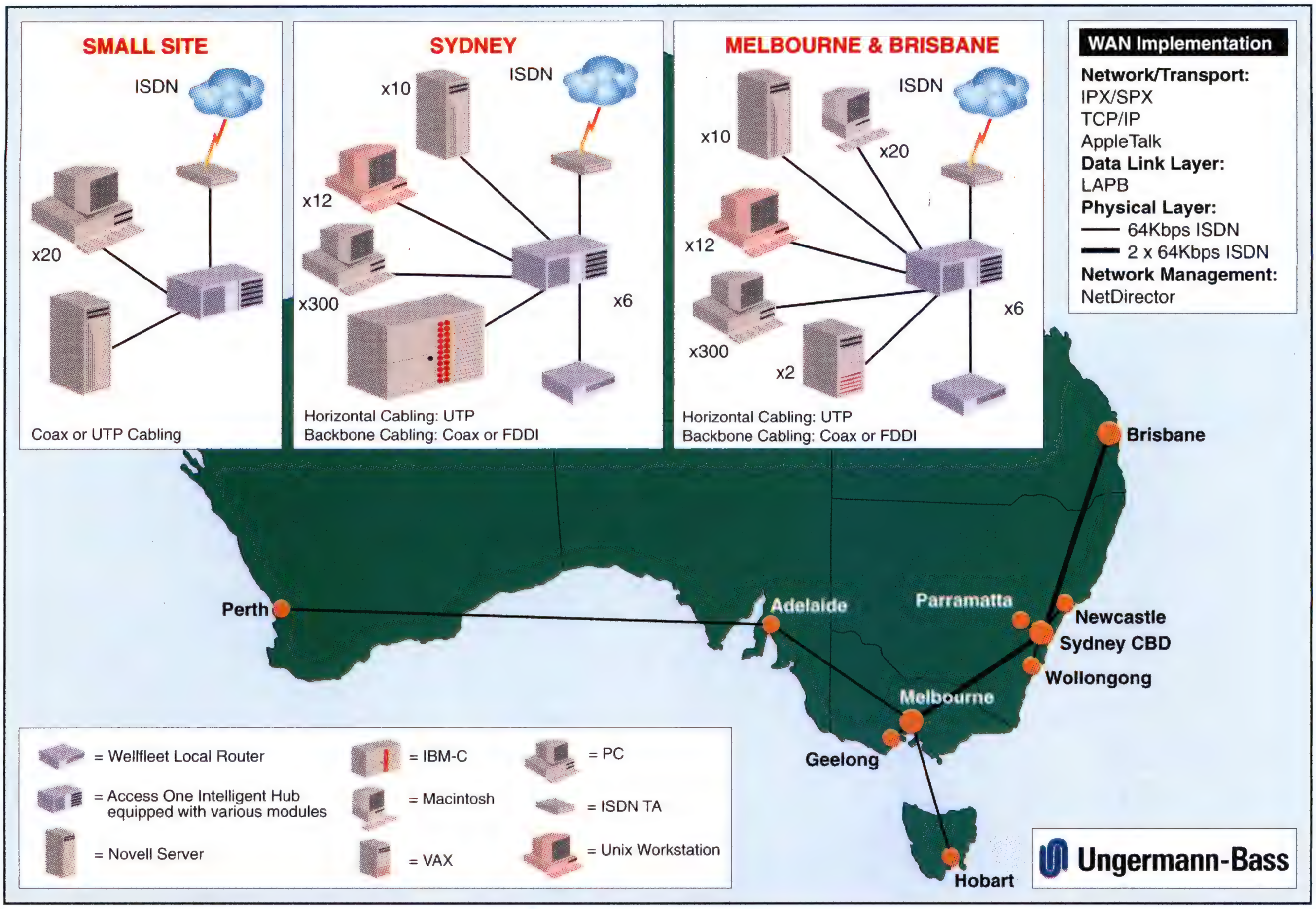

three major sites. The high bandwidth links (between RX-7000s) carry either frame relay or X.25, whereas low bandwidth links just use private X.25 (from the remote router to RX-7000). The local area physical implementation uses TCP/IP over 10Base-T, with two local bridges per floor. Each LAN segment would connect to a local bridge, DOS PCs, and a Novell server equipped with gateway software.

Sun

Sun Microsystems is a $4 billion workstation and computer networking company, which is one of the outstanding success stories in the IT industry over the past few years (Sun Australia was founded in 1986). Sun has exploited the traditional proprietary network architectures of more established vendors by using the 'open systems' approach of Unix which uses the TCP/IP protocol suite. The recession has helped rather than limited Sun's growth due to the pressures of downsizing traditional mainframe and minicomputer applications to superserver-type, peer-to-peer networking solutions.

The approach suggested by Sun is to use either its own routing software on a Sun or a third party multiprotocol router from Cisco, Wellfleet or Proteon, with dominant protocols being TCP/IP and IPX. The Macintoshes would access the Sun workstation/server which would run either PacerLink's PacerShare software or IPT's UShare software so that it would appear to the Macs as an Appleshare server.

In small sites, PC-NFS and Spry's Concurrent NFS and NetWare NDIS driver are proposed for personal computer connectivity to TCP/IP hosts.

In Sydney, Sun suggests that a 3172 LAN Channel Adaptor be used for either Token Ring or Ethernet media. The 3172 would also offer better throughput if the mainframe runs TCP/IP. SunLink SNA 3270 is used for providing connectivity from the Unix and DOS (PC-NFS) clients to the mainframe. NetWare SunLink is also proposed to provide NetWare 3.11 and gateway facilities on a SPARCserver to add to the existing NetWare servers.

The network design suggested by Sun is a tree topology using a mixture of low speed DDS for thin routes and a choice of 48Kbps DDS or 64Kbps ISDN SPC for the links between the three large sites.

Ungermann-Bass

Ungermann-Bass (UB) was founded in 1979 and is now an independent subsidiary of Tandem Computers. UB has been involved in the leading edge of data networking technology development, particularly for Ethernet, intelligent hubs and FDDI.

Ungermann-Bass' product line includes intelligent hubs, adaptors, routers, bridges, gateways, and network management. The core of the UB product range is the Access/One entepprise hub, designed for mission critical data networks. In addition, the Access/One enterprise hub includes a unique switching architecture which supports emerging multimedia applications such as voice, video, imaging and data. UB's approach to the AusComms Request For Information is to use an Access/One intelligent hub in each of the small sites and one hub on each floor of the large sites. Each hub contains appropriate LAN, WAN and management modules.

The Sydney hub is equipped with a supervisor module as well as Ethernet or Token Ring concentrator cards for PC/workstation access. Router modules interface to the WAN while a Wellfleet local multiport router segments each floor and provides a 'collapsed backbone' in a box. This partitions the traffic and avoids the installation of FDDI. NetWare for SAA and LAN 3270 workstation software are used. If SNA traffic is high, the NLM can be run on a dedicated Networth Application Engine with NetWare 3.11 Run Time instead of the network file servers.

The Melbourne and Brisbane sites use NetWare for VMS on the VAXes and a MaxTalk 16-port concentrator which routes LocalTalk to Ethernet for the Macintoshes. Also TCP/IP Unix hosts are insulated by a GARP gateway (TCP/IP to IPX). In this way

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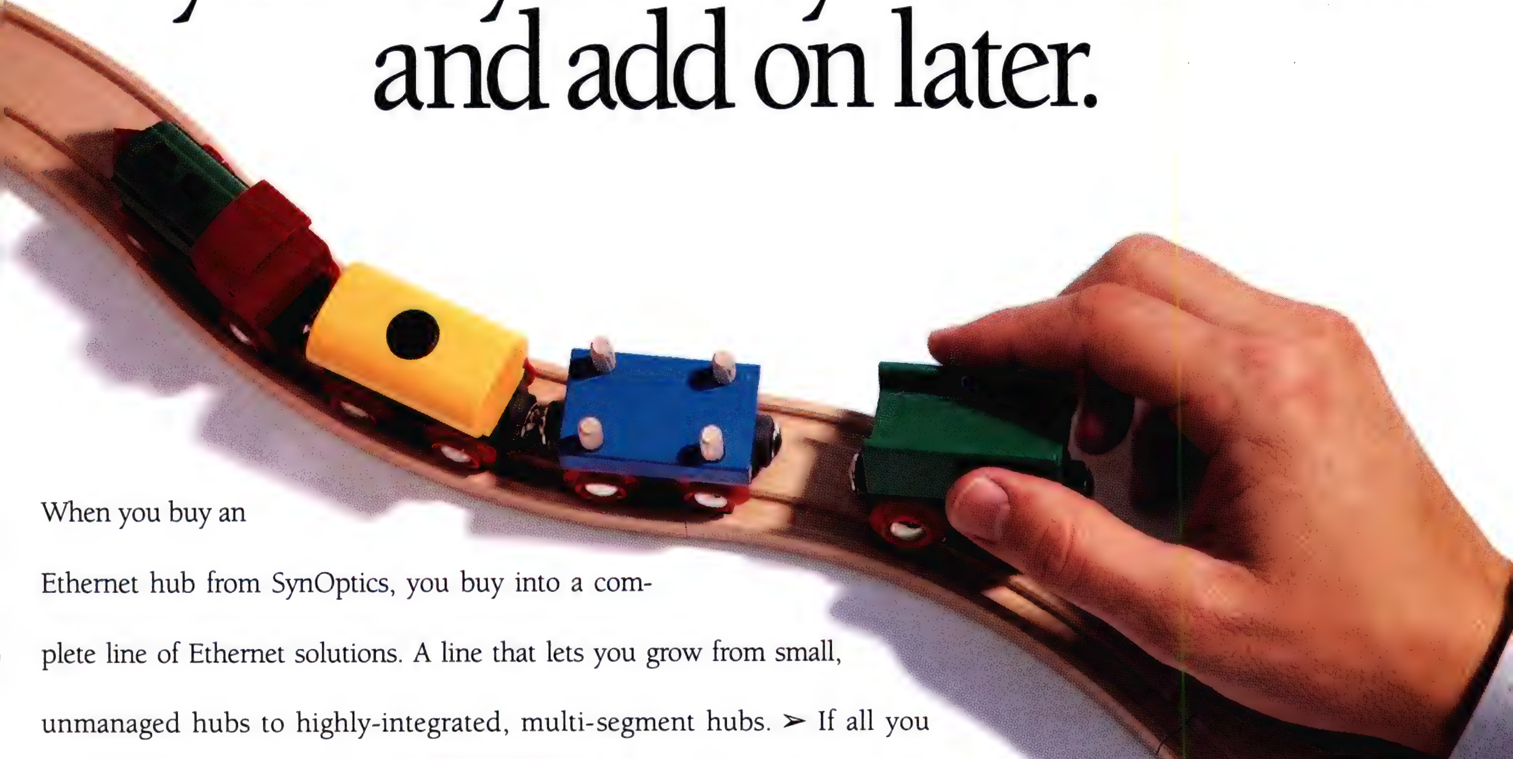

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Rating the Responses

This table summarises the standard of expertise for each vendor in each of four categories. It is not an evaluation of the proposed solutions, but rather a quantification of the perception given of each vendor's response in each of the four areas rated.

	Implementation Detail	WAN Design Issues	Appreciation of Requirements	Multiprotocol Issues
3Com	****	**	****	****
Ascom Timeplex	***	****	****	***
Bull HN	****	****	****	****
Com Tech	****	*	**	**
Interlink	*	**	*	**
NetComm	**	**	**	***
Retix	*	**	**	*
Sun	**	***	***	****
Ungermann-Bass	*	***	***	***

* Fair ** Good *** Very Good **** Excellent

Implementation Detail	This reflects the level of detail provided in the RFI response, including the specification of products, their configurations and how they are connected together.
WAN Design Issues	This reflects the vendor's understanding of WAN issues, such as the cost/quality tradeoff for bandwidth and the interaction between topology and network device functionality.
Appreciation of Requirements	This reflects the effort by the vendor to demonstrate their understanding of the requirements as set out in the RFI and their willingness to address the requirements within the broad guidelines given in the RFI.
Multiprotocol Issues	This reflects the extent of the vendors demonstrated appreciation of the various problems and issues involved in the interworking between different protocol environments.

DECnet and TCP/IP are minimised. The UB network design uses a tree topology and single or dual ISDN SPC B-channel services between locations.

No Perfect Solution

This overview of the nine responses has demonstrated a wide range of products and solutions to the AusComms Request For Information requirements. Each vendor has its own strengths which can suit various parts of the total package required.

For example, Interlink and NetComm have strengths in the equipment used for wide area networks. Sun's expertise is in networking between different de facto architectures. Com Tech clearly has a deep knowledge of Novell and SynOptics products. Ungermann-Bass is able to mix the LAN issues for large buildings with the enterprise wide requirement for connections between widely distributed LANs. Retix has a strength in its powerful router product and its X.400 software. Timeplex shows that it is a bandwidth man-agement company which has integrated LAN products into its product range. 3Com and Bull both show strengths in nearly all areas of the RFI although Bull would have the edge in its understanding of wide area network issues. Although no vendor had a perfect solution on all counts, each of the nine solutions has something of merit for serious consideration.

In the second part of this article in next month's edition of *Australian Communications* we will have a much closer feature-by-feature look at the specific functions provided by each solution as well as discussion of the more interesting networking issues involved. In particular, we will examine how the solutions compare in the functional requirements of:

- Terminal sessions;
- File transfers;
- SNA connectivity;
- DECnet connectivity;
- TCP/IP connectivity; and
- Network management systems.

We will also examine reliability, performance, options and future developments available with each solution. Particular attention will be given to the completeness of each solution, with reference to protocol handling, routing, protocol conversion, physical characteristics/interfaces and WAN features.

Brian White is a Senior Consultant at AAS Pty Ltd (Sydney) where he specialises in strategic planning, network engineering, benchmarking and communications management.

Australia's Defence Communications

Sophisticated surveillance and command and control techniques now employed by the Defence forces produce a vast amount of data. To cope, the ADF is undergoing a communications revolution.

They ran the old newsreel of the *Voyager* disaster again on TV the other week, and it must have been compulsory viewing for the Australian Department of Defence establishment. Quite a few of the experts I interviewed for this article on Defence communications networks used the idea of the aircraft carrier *HMAS Melbourne* 'which can't change course in under a few miles' as an analogy for the inertia of the Australian Defence Forces (ADF) in maintaining technologies to keep pace with the modern world. Despite the high-gloss appearance of supersonic jet fighters and high speed up-to-the-minute frigate designs, our Defence forces still communicate at data-rates first achieved on international commercial cables in the late 1800s. Defence communications, it seems, is only now moving out of the Telex and ticker-tape era.

However, before we run up the white flag and prepare to surrender, the new lean-and-mean policies of government and the retirement of some World War II-trained top brass, means that the inertia within the system has been reduced, and communications is now in a period of very rapid change in all of the forces. Communications is now seen as equal in importance to logistics in maintaining fighting efficiencies at the front line. Last August, Plessey handed over to the Operations Division of the ADF the first elements of DISCON (Defence Integrated Secure Communications Network) which is a digital communications network from the era of ISDN. It's taken 12 long years of hard slogging by the soldiers in communications policy to get this network accepted and up to speed. But, to be fair, I guess you could also say that about Telecom and its foray into digital communications; after all, ISDN was first formulated in the early 1980s also.

The ADF is now looking even further ahead in its communications planning (although not without resistance in these days of economic problems). In the planning stages it has DORIC (Defence Organisation Integrated Communications) which is a package of technologies based on future broadband networks — using SDH, ATM and Fastpac-type MANs. Australia should have the main elements of DORIC by the end of the century — about the time B-ISDN will begin to make an impact in the commercial world.

The DSTO (Defence Science and Technology Organisation), the military's version of the CSIRO, is now in the forefront of R&D in a number of these new high-tech communications technologies, to a surprising degree. It has a Memorandum of Understanding (MoU) with Telecom Research Laboratories (TRL) for joint work on fibre optics and Broadband ISDN and, of all things, they seem to be Australia's experts in High Definition Television (HDTV). In the High Frequency (HF) radio area, the DSTO has only recently made a couple of breakthroughs which have both civil and military applications. A team led by Dr Stephen Cook and Jason Scholz invented EVEREST (Extremely Versatile Error Rate ESTimator) which keeps track of rapidly varying channel quality (a constant problem with HF radio) and they've designed new detectors, and the ACROBAT (Adaptive Code Rate Transmission) system which can predict fading phenomena, and adjust the error-checking protection component of the data-stream to greatly improve throughput.

A Defence Communications Primer

ACROBAT — Adaptive Code Rate Transmission. This concept is under development for HF radio. It will use EVEREST as a predictor of fading problems and adjust the error-protection system accordingly. This provides much greater throughput on links, or allows the same quality of service on low-power transmitters.

ADF — Australian Defence Force

AOCS — Air Operations Communications Systems. The Air Force uses HF, UHF and VHF links to aircraft from its centres at Sydney, Perth, Darwin and Townsville, and these are inter-linked by the DISCON network. Butterworth, the Malaysian base, and a New Zealand station in Auckland extend the network.

CDF — Chief of the Defence Forces. The top ADF officer with responsibility for planning and conducting military operations, and ensuring military preparedness.

DEFCOMMNET — The Defence Communications Network consists of HF radio and microwave links and leased Telecom lines, exchanges and message centres. This is the old system of Telex and Teletype which is now being replaced by DISCON.

DESINE — Defence EDP System Integrated Network Environment. Aims to provide common Management Information Systems.

DISCON — The Defence Integrated Secure Communications Network is now being introduced to replace DEFCOMMNET. It's a 64Kbps digital system which can provide secure integrated voice, data, facsimile and messaging services using leased Telecom lines (with Defence-owned exchanges), Optus satellite services, and HFALE and microwave radio links.

DMCN — Defence Mobile Communications Network. The general term for satellite-based communications using the Ku- and L-band. It includes the MILSATCOM project.

DORIC — Stands for Defence Organisation Integrated Communications. A new major program for future integrated communications systems where everything goes through the one civil/defence network by the end of the century. This program is leading in the direction of SDH, ATM, Broadband ISDN, and Fastpac MANs.

DPSDN — The DISCON Packet Switched Data Network. This is a secure X.25 network now being put into place on the DISCON network.

DSD — The Defence Signals Directorate is responsible for intelligence gathering and defence communications security measures.

DSTO — The Defence Science and Technology Organisation. The main defence research organisation — the military equivalent of the CSIRO — which is based in Salisbury, SA.

EASYCOM — A small black box which sits below the handset or computer terminal and allows voice, data and facsimile services across the public-switched network at military grades of encryption (using a NSA-approved algorithm). It is the result of a cooperative venture between DSD and AOTC's research laboratories. Easycom is a 64Kbps ISDN device so it has good data capability, and it doesn't need to be rekeyed often. Defence believes that there is enough government and corporate interest to generate industry involvement for commercial production.

EVEREST — Extremely Versatile Error Rate ESTimator. This is an error-prediction technique which functions at an extremely rapid rate and provides the essential information needed by the adaptive radio system (HF). This is a new, and very sophisticated approach to error control which has wide application in any digital data system (including civilian cellular radio).

HFALE — High-Frequency Automatic Link Establishment. An automated version of the long-distance HF radio links which performs polling, monitoring and frequency hopping to maintain signal strength and throughput.

MEEN — Minimal Essential Emergency Network. The maximum security network wholly owned and operated by Defence. It uses digital services over HF circuits using Automatic Link Establishment-type (HFALE) equipment.

MILSATCOM — A project for acquiring Mobile-Sat (L-band transponder) capability with the Optus Series B satellites.

MILSPEC — MILitary (proprietary) SPECifications for equipment, as distinct from general international (ISO) equipment specifications.

NAVCOMMSTA — ADF-speak for Naval Communications Stations. Some of these installations are now being taken over for use by Joint Service operations.

PARAKEET — a tactical 'trunked-radio' system still under development. It aims to provide forward battle groups with transportable HF, UHF microwave and satellite links back to their headquarters, and then to the major defence communications networks. It has circuit, packet and message switching elements, and it is designed to provide the link between DISCON and RAVEN.

RAVEN — This refers to both the single-channel 'combat-net' single-channel radio units, and the tactical network linking them to their headquarters. There are two versions; a small HF RAVEN which is currently in use for low-bandwidth voice and data with a range up to 'hundreds of kilometres,' and a later, smaller, VHF RAVEN with more bandwidth, but only for line-of-sight communications. These are 'ruggedised' modular units with man-pack, vehicle and headquarters versions.

VIDCONNET — The proposed future Video Conferencing Network which will run over aggregated 64Kbps DISCON channels.

EVEREST, they claim, is 10,000 times as fast at predicting problems as current systems which rely on checking known 'training sequences' of data, and the development of ACROBAT and the new detectors will allow them to achieve HF traffic flows with a 40 Watt transmitter which can now only be achieved with 10,000 Watts. Shortly, the DSTO expects to be sending reliable data-rates of 48,000bps over HF, and this will be enough for slow-scan video. The days of HF radio are by no means at an end.

Brigadier Neil Horn, Director General of Communications Engineering, says that "In a strategic sense, there is some reduction in emphasis on HF, but when you go out into the field at the tactical end, there is going to be more and more emphasis on HF simply because we need it for range. Cambodia is a classic example; without the HF Raven (the current man-pack radio) we couldn't be doing the job we are in Cambodia."

"The value of the next-generation VHF Raven over the present HF Raven is that it gives you wider bandwidth. You can put 16Kbps of secure voice and data over VHF radio, but you can't ever have that over HF radio. VHF is for operational units, over shorter distances up to 15 to 16km where it can give you more reliability and guarantee you a connection. In that zero to 15km range, HF is unreliable." HF is, of course, still used over the longer 'short-wave' distances to ships and to aircraft, but satellite communications is gradually taking over here.

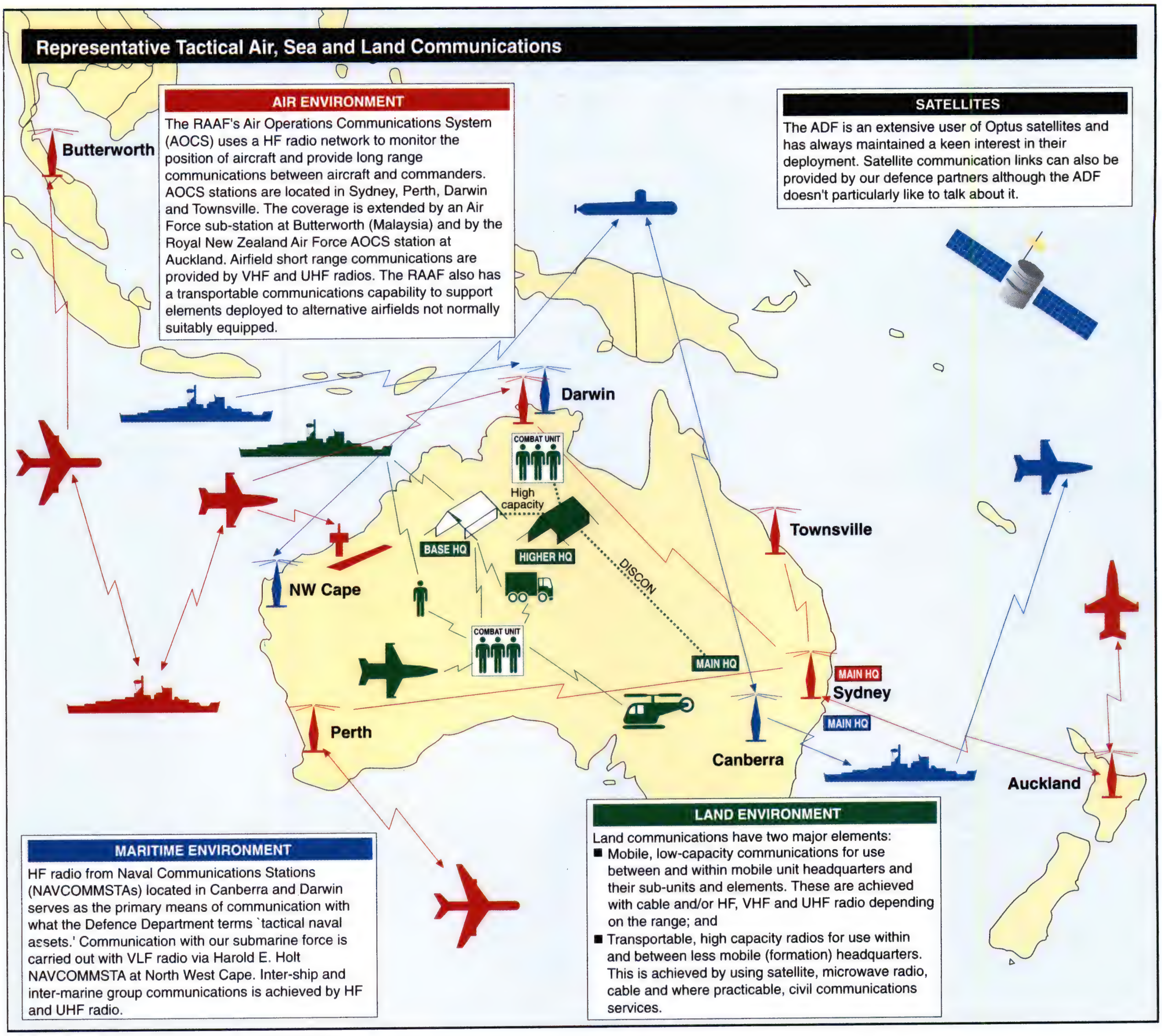
One clear trend in military communications, is a shift away from reliance on MIL-SPEC (military-specific specifications) for communications equipment to those with wider commercial use. Commercial systems are faster to evolve and have the benefits of lower costs and interconnectivity with the commercial carriers. ISO and the GOSIP standards are coming into Defence.

The technologies being designed into the futuristic DORIC for instance, are those that the commercial world will use on B-ISDN networks and X.400/X.500 message-handling is the way of the future for both military and commercial electronic mail. Even EVEREST and ACROBAT will be commercialised by Australian industries and sold around the world to HF users — emergency services, coast guards and customs.

"DORIC will give us the path into the ATM, SDH and Broadband ISDN arena," Neil Horn explains. "The backbone services we are now building will produce an enormous change, and we'll realise the gains both in productivity and in dollar terms in the coming seven or eight years."

DORIC is seen by most to be SDH and B-ISDN under a military guise (with extras added), but Lt. Col. Ted Younger, Deputy Director of Advanced Communications Development, says they are not prepared to make the assumption that DORIC will be totally based on ATM cells. "Certainly the biggest problem for Defence communications is the 'disconnect' between where general communications is now going, and our primary needs for front-line access," he says.

There's also a shift from reliance on military-exclusive networks to private networks provided by the carriers. However, Defence


Representative Tactical Air, Sea and Land Communications

AIR ENVIRONMENT

The RAAF's Air Operations Communications System (AOCS) uses a HF radio network to monitor the position of aircraft and provide long range communications between aircraft and commanders. AOCS stations are located in Sydney, Perth, Darwin and Townsville. The coverage is extended by an Air Force sub-station at Butterworth (Malaysia) and by the Royal New Zealand Air Force AOCS station at Auckland. Airfield short range communications are provided by VHF and UHF radios. The RAAF also has a transportable communications capability to support elements deployed to alternative airfields not normally suitably equipped.

SATELLITES

The ADF is an extensive user of Optus satellites and has always maintained a keen interest in their deployment. Satellite communication links can also be provided by our defence partners although the ADF doesn't particularly like to talk about it.

MARITIME ENVIRONMENT

HF radio from Naval Communications Stations (NAVCOMMSTAs) located in Canberra and Darwin serves as the primary means of communication with what the Defence Department terms `tactical naval assets.' Communication with our submarine force is carried out with VLF radio via Harold E. Holt NAVCOMMSTA at North West Cape. Inter-ship and inter-marine group communications is achieved by HF and UHF radio.

LAND ENVIRONMENT

Land communications have two major elements:

- Mobile, low-capacity communications for use between and within mobile unit headquarters and their sub-units and elements. These are achieved with cable and/or HF, VHF and UHF radio depending on the range; and
- Transportable, high capacity radios for use within and between less mobile (formation) headquarters. This is achieved by using satellite, microwave radio, cable and where practicable, civil communications services.

still distributes its most critical information over its own HF network.

And even when military information passes over Telecom's optical fibres or the Optus satellite, there's always a need to take the final delivery hop over a HF or UHF link in spectrum reserved for defence purposes. There's a dichotomy here between the front-line MILSPEC-type 'ruggedised' equipment and the move to ISO standard equipment which will be favoured for Defence's main multiplexed bearer services.

"Communications is being pushed by industry rather than Defence these days," explains Ted Younger, "and all these technologies are predicated on the fact that an office PC can be connected to a broadband transmission system of one sort or another. Unfortunately for us, it's very difficult to plug that fibre optic cable into the back of an F-18 fighter or a ship, so mobility is the key difference between the services and where general communications is going."

The 'sharp end' with the infantry, relies on combat-radio which has low-level bandwidth requirements, but further back in the support areas and the major headquarters, they need to aggregate communications requirements. Further back still, at the Brigade headquarters, they've got the equivalent of a fairly sophisticated small town, and then at Divisional headquarters, they have a quite sophisticated large town.

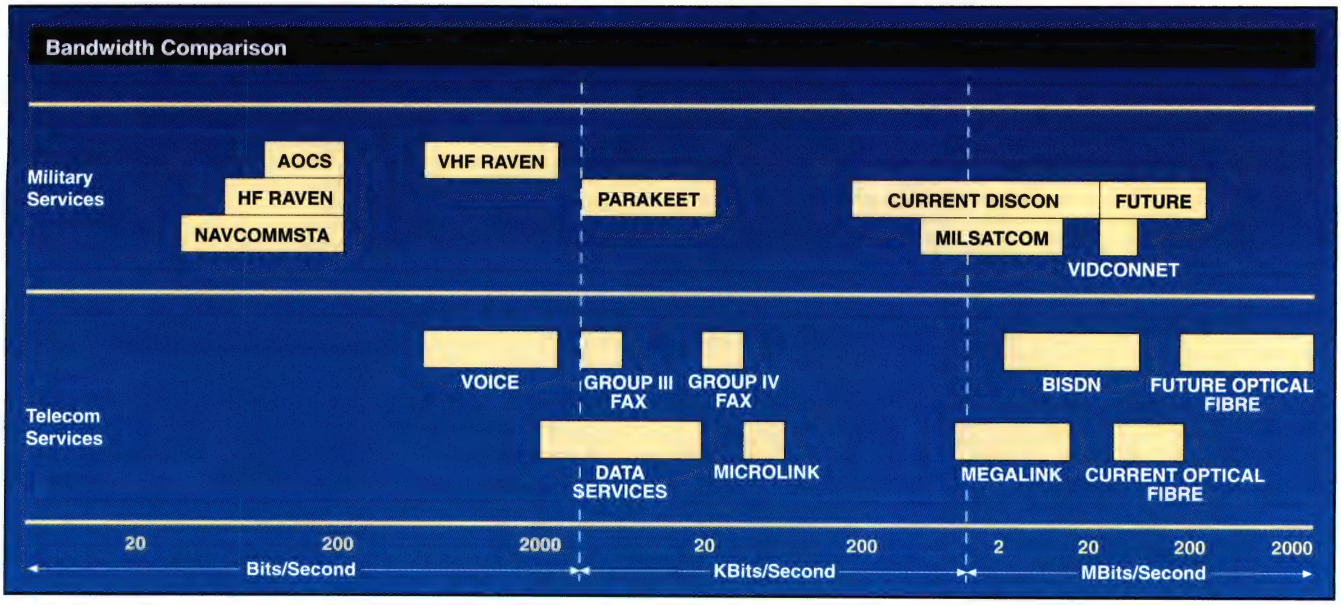
"And these headquarters move quite regularly, so you are picking up a town's worth of communications and moving it around the country," Younger says. "Our design concept is based on the fact that you will always have some sort of civil infrastructure to plug into. But you then need to extend the capacity and diversity of media so as not to be totally dependent on, say, the fibre optic cable from Alice Springs. Parakeet will eventually provide that."

Parakeet is a new communications project (not yet in the trial stages) for a telephone system for these forward headquarters. It has a switching system (circuit and message switch) on land-lines, and it uses reasonably high-capacity microwave bearers and the Ku-band on the satellites as well. The formal documentation on Parakeet says it is 'to provide users who are located at Formation and Logistical Headquarters, with voice, telegraph and data and fax services,' and it has a trunked-switching capability.

It will give any forward headquarters a total bandwidth of more than 2Mbps, and the satellite's reach will extend out into the field to provide multi-channel data and voice with individual circuits at the 2.4Kbps level. By aggregating these channels they may be able to shift high quality images out to command and control workstations in the field also.

Inadequate Infrastructure

The main problem Australian Defence planners face is that our civil telecommunications infrastructure is fairly rich down in the south, the eastern and the south-western parts of Australia, but (as one person put it) "once you cross the Murray/Darling line, Telecom's network can be characterised as two pieces of string and a couple of tin cans, despite what the AOTC advertisements say." Ted Younger



puts it more diplomatically; he says that "outside the south-eastern corridor, connectivity reduces somewhat!"

Colonel Gus Kollar, Director of Communications Development, agrees that Australia's southern states concentration is a major problem. "It's a huge challenge because unfortunately we rely heavily on Telecom's civil infrastructure to provide our transmission bearers and, in Australia, the civil infrastructure is designed around the central business districts."

"In the north and northwest where bearer capacity is very sparse and low in bandwidth, we need to compliment the civil infrastructure in order to move information from where it is gathered, to where it can be processed." Fortunately, Telecom is said to be putting in a broadband link to Darwin in 1994.

Jindalee, the over-the-horizon radar system jointly developed by the ADF and Telecom, is a good illustration of the outback isolation problem. "Jindalee is a big sponge as far as we are concerned," Kollar says. "It absorbs intelligence and tracking information and then, after an initial processing and culling stage, we need to pass that information back to where it can be processed."

Communications Policy

Talk to a number of the top communications people from different divisions, departments and services, and you'll find remarkably little divergence of views on the problems — and on the ways of solving them. At ADF Headquarters and within the three service divisions, there's wide acceptance of the current communications policies. I guess when you are moving from Teletype to ATM and videoconferencing in a decade, you won't find too many people complaining.

The main relevant area for communications policy is within the Development Division at ADF Headquarters. The Communications and Information Systems branch there is where most of the forward strategic planning takes place. This branch has five Directors each responsible for different areas of long-term policy in communications and/or computer technologies.

The main thrust for change seems to come from Colonel Gus Kollar's Communications Development branch, and he does not pull any punches about the state of military communications until recently.

"Oh I think we are still pretty primitive — we use very low data-rates," he says. "This is the difference between us and Telecom; we are really down in the 20bps range even with some relatively new services. The Air Operational Command System [for aircraft] is a HF-bearer/low data-rate service, HF Raven [radio for the front-line troops] is low data-rate, and the Naval Communications Stations are all 75bps — essentially still using Telex and Teletype."

So while the futurists talk about gigabit optical fibres and broadband systems, Defence has its immediate focus on introducing X.25 packet-switching and X.400 electronic messaging as the backbone of strategic communications. And this isn't just inertia or stupidity; there are a number of very practical reasons why low data-rates still hold such sway in these areas.

The first is that the communications chain is only as strong as its weakest link; and in defence terms, the weakest link is their reliance on the HF radio link to front-line operational units. There's not much point in zapping multi-megabits of video/voice over fibres and satellite circuits, and then only bridge to the front-line at 20bps. And, given the vagaries of the current HF equipment, this seems

The Problems of Interoperability

Probably the most valuable lesson to come out of the Gulf War was the need for interoperability of communications links between the various allies, and also between different national defence services. There is a well-known story that US Air Force orders for aircraft support had to be man-carried out to the Navy's aircraft carriers because the two services didn't have a secure, workable communications system.

"Interoperability was a problem in the Gulf War," admits Brigadier Neil Horn, "but that is hardly surprising considering the number of nations there. Think of the diversity of equipment employed: You had the Syrians with Soviet provided equipment, and you had the British, French and Americans, and even with NATO, this is still a general problem."

"The OSI approach is everyone's earnest attempt to overcome the problem, but it must get down to the basic-level protocols with HF radio. If you've bought 'Brand X' rather than an ISO standard, you are never going to get interoperability. Even within your own organisation, once you buy Brand X you are stuck with growing that into a total system, or having black boxes, interfaces and all the rest of it, all over the place."

Through years of uncoordinated purchasing, Australia's Defence services face many of these problems, and so ADF priorities are towards setting their its own house in order before venturing into the mine-field of international interoperability. Stage 1 is for each service to achieve interoperability within its own area; Stage 2 is to provide exchange between all three services; Stage 3 is to create interoperability between Defence and our national carriers, and only then will they look in Stage 4 at links with our allies.

Stewart Fist

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The DISCON Future

The first stage of the new Defence Integrated Secure Communications Network was handed over by Plessey in August 1992. It will gradually replace the Telex-based DEFCOMMNET and carry traffic up to the level of Secret.

DISCON is a fully digital (ISDN-like) system which can provide secure integrated voice, data, facsimile and messaging services using a combination of leased Telecom lines (with Defence-owned exchanges), Optus Ku-Band satellite services, microwave bearers, and HF links from the major NAVCOMMSTA (Naval Base Stations).

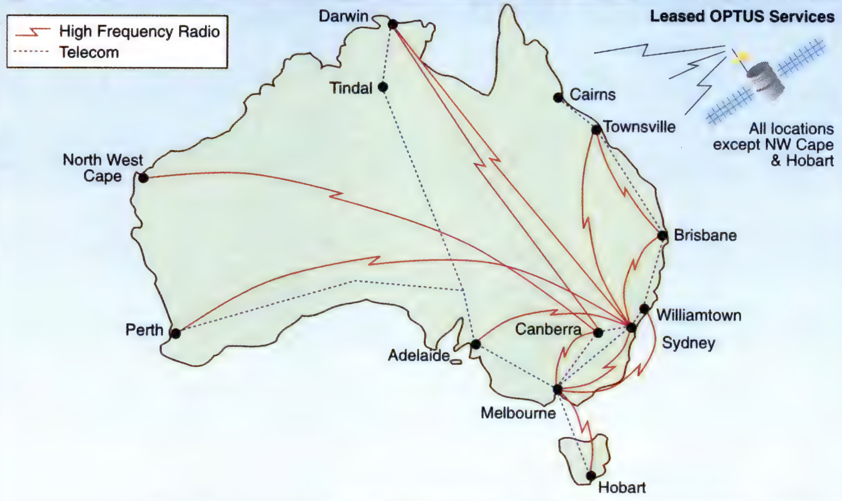
Currently there are 630 telephones, 110 workstations and 225 telegraph terminals distributed over 144 DISCON sites in Australia. The voice-telephony services include conference and broadcast facilities, and high grade facsimile is available for the reproduction of maps and photographs using 16 levels of grey-scale. All information passed over the network is automatically encoded and decoded.

The workstations are both special-built ruggedised terminals for general field use, and PCs with special software. They all have facilities for simplified message formats which allow DISCON to interface directly with the tactical communications networks, Parakeet and Raven.

DISCON switching centres are in Canberra, Melbourne, Sydney, Perth, Brisbane and the Air Force base at Tindal. Survivability of the network is ensured by always providing backup links. Public network lines, for instance, always have parallel satellite, microwave or HF links.

Stewart Fist

The Defence Integrated Secure Communications Network



to be roughly the average data-rate expected today by the infantry and the Navy.

The second point is just as important. In times of war, high bandwidth circuits just can't be guaranteed. If you postulate communications networks and procedures on the expectation of using voice, video and imaging, then you are highly vulnerable.

Saddam Hussein learned this lesson; the first American target in the first day of the Gulf War was AT&T's telecommunications switching centre in Baghdad. So it makes sense to concentrate essential communications on short-messaging services divertible to radio links, which can provide security and reliability if main trunks and switches are knocked out.

The third relevant point is that bandwidth can only be guaranteed within the confines of the Australian continent. Even with a final HF radio hop from the large Naval Communications Stations, they are still not carrying traffic far beyond the continental shelf. Between a third and a half of all the new DISCON (Defence Integrated Secure Communications Network) traffic is carried over Optus satellites with footprints only just extending to Papua New Guinea, and 90% of all traffic is carried by the satellites and land-lines.

Since the end of the Cold War, the focus has shifted back to continental Australia, and so the current communications emphasis extends offshore only to support our near neighbours (mainly PNG). "The real reason for promoting these higher bandwidth services is to get all the information pertinent to a topic into one place," explains Air Commodore Neville Middleton, Director-General, Joint Communications/Electronics. "In previous times we would call up someone and have them prepare a report, but now we need to access large databases electronically and take images over the network ourselves.

"So high-bandwidth services are not being put in place just for the peace-time military; high-bandwidth will have even more significance in war. Our greatest requirement is for images from satellites, aircraft and ground video, and we also need bandwidth to transfer map and diagrammatic information."

"We learned in the Gulf War that TV news cameramen, like those of CNN, were sending scenes of the fighting around the world instantly, and the military can't afford to be without a similar capability. There are both military and political implications here: The public and politicians want an instant response to what they see on TV, and so we need to acquire, process, and pass on these images for analysis and 'data-fusion' (the merging of information sources) before our analysts can see, and present, the true picture — and these are all high bandwidth requirements."

"There's also been an enormous increase in the number of circuits and the amount of data traffic for logistics support," he adds. In the Army that means everything from trucks to water supplies; in the Air Force it means mainly spares for the planes, and in the Navy it covers everything down to toothpaste.

So the plan for the year 2000 is to provide four levels of communications network services. At the top there will be MEEN (Minimal Essential Emergency Network) which is a highly secure, short messaging network which may only service a hundred or so terminals. MEEN will carry, at most, 5% of the total traffic and it will use HF radio circuits.

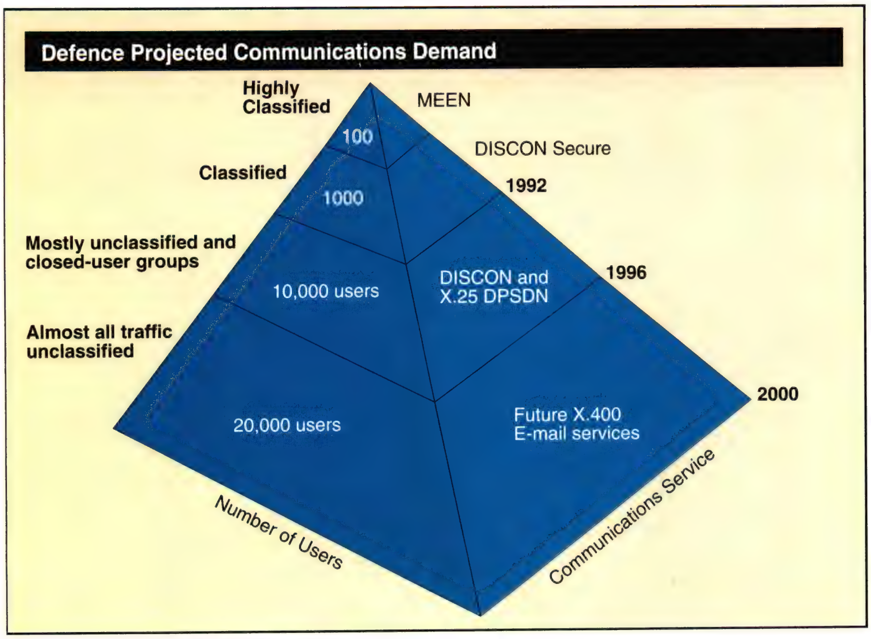
The new MEEN digital system will run at 1.2Kbps (voice and data) using HF Automatic Link Establishment (HFALE) techniques which were devised by the US defence services. Australia will shortly be covered by a number of HFALE stations, generally co-located with DISCON switches.

Below this will be DISCON which is now (from this year) being introduced to replace DEFCOMMNET, the ADF's current Telex-based secure backbone.

On the back of DISCON rides the workhorse of military communications — called DPSDN (DISCON Packet-Switched Data Network). The initial planning base was for 4,000 terminals on this network, but in the three years it took to put the project together it went up to 10,000. "We now expect it to go to 20,000 terminals over a further 3-5 years, so it will probably be the largest packet-switching network in Australia," Neil Horn says.

DPSDN is a private X.25 network which will take EDI and EFT as applications. It is overlaid on DISCON, and its major packet switches and concentrators are co-located with DISCON's switches, and it extends from these switch centres into the facilities areas (the base locations) in a specific (mainly State-wide) region.

It serves the total organisation without discriminating between service and civilian branches, and the two principle users will be the financial and the supply systems. So the DPSDN has two security levels: DEFAUSPAC to handle material classified below the



Defence Projected Communications Demand

Restricted level, and DEFSECPAC which is intended to handle material classified as Confidential and above.

"At the moment we use X.25 because it is proven, well-established and is a well-accepted international standard which we can accommodate quite easily and work with very, very easily," Neil Horn explains. "We expect to move to frame relay later when this technology becomes better established in the marketplace."

An even larger group of users (more than 20,000 terminals) will shortly be introduced to X.400 messaging, and it is expected that, eventually, much of the DPSDN traffic will migrate to X.400 services. This is the major communications project on the books for 1994/5. X.400 (with X.500 directories) will be the tie-that-binds all Defence communications together, and provides them with direct access to other government departments, and to the civilian suppliers.

"We are used to moving only about one 1,000 character message per minute," says Gus Kollar, "and shortly we will have 3,000 characters or an A4-page every second, and that's a major achievement. We have a culture which tends to be minimal in terms of communications demands, but only now under DISCON are we are able to provide even these bandwidths. The civil community has been used to these rates for many years now, but it is a different culture."

In these stringent financial times, the low cost of messaging is also a very practical reason why X.400 is assuming such importance. The Defence Department is a major customer of Telecom — perhaps about $65 to $70 million a year — and it does not see its communications budget increasing. But demand is going through the roof.

Given this financial incentive on both sides, it is not surprising that currently relations with both Telecom and Optus are good, but there must be some suspicion that Defence could eventually evolve its own network which, in peace time would sub-let bandwidth to other government departments as a way of offsetting costs.

"I don't think we would hurt Telecom in providing carrier-type services. We're not in that business," Gus Kollar says. But they are actively involved in the Department of Finance's initiatives to establish a Federal Government network, and they seek cooperation with other government departments in sharing services, so it is doubtful that Telecom are too pleased."

"Foreign Affairs and Trade have communications links going into Washington and London and we also have staff there, so it does make sense to share that kind of bandwidth," Kollar explains. "The deal we would like to see, is an exchange here for us providing them with bandwidth within Australia. These are very useful discussions and they look positive."

"Similarly we would see ourselves providing bandwidth to other government departments — the Australian Tax Office is a wide bandwidth user, and there's Customs and the CoastWatch which have similar needs to our own."

Defence got very nervous when Aussat was being sold — not the least because their interests were supposedly being represented by the Department of Transport & Communications (DOTAC) which had another agenda — that of flogging the satellites for the maximum possible price.

"We were all walking on egg-shells for a time," says Kollar. "These were fundamentally different goals. We are big customers of the Ku-band already, and we had planned to acquire a MobileSat capability. In fact we may yet be the only significant customer that Optus has for the L-Band service," he says.

Stewart Fist is a freelance journalist based in Lindfield (NSW).

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Distributed Systems: A Peek Inside Pandora's Box

Conventional wisdom has it that a PC-based solution makes for the most efficient and cost effective distributed system. But is that really so? Graeme Le Roux compares Digital's offerings with the PC world.

Even the most bigoted PC evangelist has to admit that there are times when a computing task is simply beyond a PC-based system. Conversely, PC-based distributed systems can perform many of the tasks traditionally assigned to a minicomputer or small mainframe. When is a minicomputer-based system more cost effective than one based on PCs? For that matter what is the difference between a small minicomputer and a 'PC Server'? In an attempt to illustrate some of the issues involved in answering these questions, if not to answer them directly, I decided to write three simplified network scenarios and, in each case, try to contrast a solution based on PC technology with one based on products from a 'traditional' minicomputer vendor.

I chose Digital Equipment Corporation as my generic 'traditional' vendor because it has significant experience in distributed systems having used them internally for some years and has an extremely broad client base. Digital's products are recognised as dependable and scalable workhorses by just about everyone.

On the PC side of things I chose Compaq as representing the 'industry standard' PC. Like Digital, Compaq produces a broad range of well-engineered machines that are used in a wide variety of applications in their chosen market. Many of those applications come from Microsoft which is also leading the charge in trying to convince business at large that real business systems can be built cost effectively on a PC platform. Like Digital, Microsoft manufactures a broad range of software from operating systems through applications to compilers. No other company in the PC industry manufactures such a complete range. Finally, to match Digital's expertise and products in the area of transmission systems, I chose 3Com. 3Com manufacture most of the world's network adaptors and the company has a fully integrated range of hubs, routers and bridges.

I could just as easily have chosen products from a variety of other vendors. I did consider several such options, however I found that each company's products have limitations and features that tended to balance out in most combinations. My choice also minimised the number of vendors I had to deal with and thus saved me considerable time. I'd also argue that if I actually began a project that required the cooperation of more than three vendors it would significantly increase the time and cost of the project. In any case many of the conclusions I've reached have little to do with individual product lines.

Different Cultures

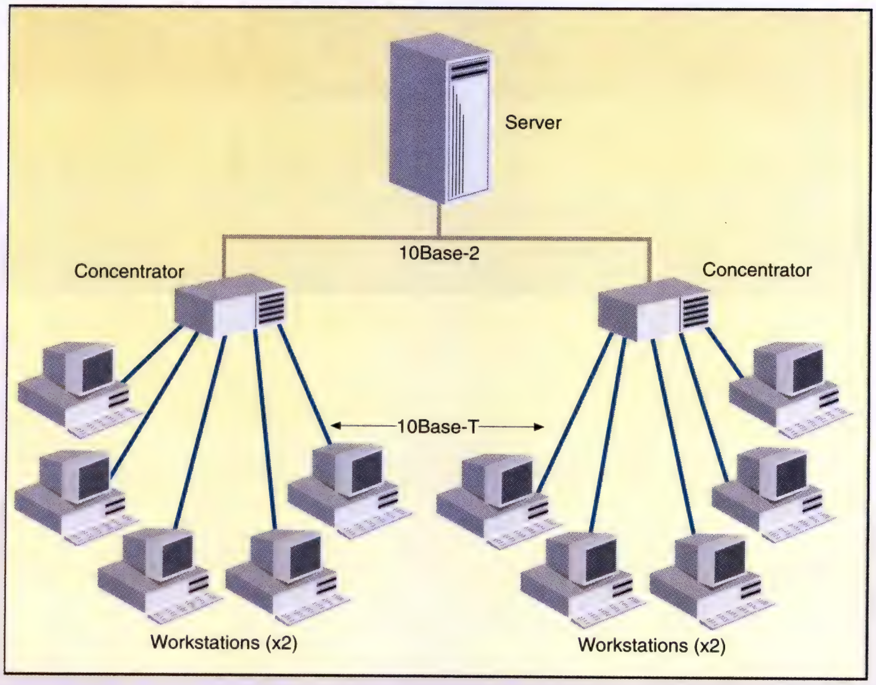
The first and most painfully apparent of those conclusions is that Digital can supply technical information to the would-be system designer much more efficiently than the PC industry. It took just about three hours of my time to get in touch with the appropriate people, explain my needs and collect all the information I required (much more than I required in fact) and to put together a proposed configuration for my three scenarios. To get to the same point with Compaq/3Com/Microsoft (hereafter known as C3M) took about 48 hours of my time. In fairness to C3M I have to point out that this is due to a basic difference in organisation and customer approach rather than incompetence or disinterest.

Scenario #1: The Typical LAN

This scenario is intended to contrast C3M to Digital as an alternative for a typical LAN. In Australia a 'typical LAN' is usually owned by a small business or a single department within a larger business. This was the scenario put to C3M and Digital:

'A 20 workstation LAN with single server. All workstations are to be GUI clients. Future expansion is planned (10 workstations) along with a small to medium size database application.

This application will probably be client-server based. These additions must be accomplished at minimal future capital cost and with no disruption to users. Other than expansion as per above and possible memory upgrades to server and workstations it is planned that the system remain 'as is' for a period of not less than four years and not more than six, though this maximum maybe extended. Basic system administration and user training should be available where it is required.'



Base Requirements

Workstations:
- 80386SX @ 25MHz or better
- 4 MB RAM minimum expandable to not less than 16 Mb
- 80 MB hard disk minimum
- VGA or better on 14" monitor
- Mouse & 101 Keyboard
- Microsoft DOS 5.0
- Windows 3.1

Server:
- 80486 @ 33Mhz or better
- 16 MB RAM minimum expandable to at least 32 Mb
- 1 GB hard disk expandable to not less than 2 GB internally
- 1 GB DAT Tape Back-up unit and software
- Ability to use a w/s monitor for console
- Mouse & 101 Keyboard
- One Serial port minimum
- One Parallel port minimum
- OS/2 V1.31
- Microsoft LAN Manager V2.1 & SQL Server

Printers:
A single, dual bin, 12 page per minute postscript capable laser printer with an envelope feeder is required. Throughput will be around 10,000 A4 pages per month.

One dot matrix printer capable of high quality output and a speed of not less than 200 ch/s in draft mode on 15" single part forms. Throughput will be around 4,000 pages per month.

Transmission System:
Workstations are to be connected via 10Base-T to concentrators (which must have at least one spare port). Concentrators will be connected to the server via a single 10Base-2 segment. Cabling must comply with IEEE specifications.

Support & Service:
All hardware, software and services to be fully warranted for not less than 12 months. Warranty should provide a suitable mix of telephone and on-site support/service. Post-warranty support/service contracts are also required.

Firstly Digital is a 'one-stop-shop' and as a result the Digital employee who 'owns' the enquiry has reasonably direct access to all information required. C3M are three distinct companies in three different locations and so this is not possible. Further, the sort of query I presented to Digital is commonplace. This is not the case for C3M where a prospective customer usually goes to a dealer or a consultant, not the vendor. It is usually the dealer or the consultant who approaches a vendor's sales or support personnel for confirmation that system components will work as planned. In many cases customers, particularly large corporate clients, present dealers with a list of products and simply ask for a price. In strategic cases C3M can and does get directly involved but this is done on an ad hoc basis rather than as standard operating procedure.

The very basis of sales in a PC environment differs from that in a traditional environment. Firstly traditional vendors like Digital, while making every effort to accommodate customers, will not make an unprofitable deal. The reason so many PC dealerships have disappeared lately is because they will cut their margins to ridiculously unprofitable levels.

Secondly, while Digital and the rest of the traditional industry make a healthy profit from sales, they rely on support contracts to pay the bills. In fact support could be considered as the industry's primary business. This provides a degree of stability that does not exist in the PC sales channel. In the PC channel sales pay the bills and as a result volume must be maximised, often at the cost of pre- and post-sales support capability. While it is dependant on the present channel structure and large customers that buy purely on price (often to their own future cost) it is hard to see how the PC industry will rectify this unstable situation and thus be able to compete with traditional vendors on the basis of pre- and post- sales system support.

The most basic requirement for the successful deployment of any core business system is stability. Stability requires ongoing support, maintenance and technical expertise. Hopefully the remaining personal computer dealerships and their customers will realise this before PC vendors are forced to sell direct due to a lack of sufficient dealerships to move their products in reasonable volume. This would be regrettable since vendors can't sell and support integrated systems. Only a dealer can integrate products to provide this service.

A Server is a Server

At the heart of any distributed computer system is a set of machines (commonly known as 'servers') that host the back end of the application. Whether these machines are purchased from little-known clone manufacturers or from leading vendors like Digital, Apricot, IBM or Compaq they cannot be considered as 'commodity items.' Without a reliable platform on which to run, the best system in the world is useless. Further, stripped of their software a Compaq SystemPro

DIGITAL

ITEM	QTY	RRP	ITEM TOTAL
MicroVAX 3100 M30 with 16 MB RAM	1	$14,658	$14,658
1.05 GB SCSI Hard Disk	1	$4,785	$4,785
4.0 GB DAT drive	1	$5,775	$5,775
CD-ROM	1	$1,403	$1,403
OpenVMS Media & Doc on CD	1	$1,040	$1,040
NAS200 Media and Doc	1	$4,210	$4,210
Total for Server:			$31,871
DECpc 325SX-LP with 4 MB RAM, 105 MB Hard Disk, Mouse, Super VGA 14" Monitor and DOS 5.0 plus Windows 3.1 pre-installed.	1	$3,430	$3,430
PathWORKS client licences	1	$287	$287
DEC EtherWORKS Turbo/TP adaptors	1	$551	$551
Total per General Workstation:			$4,268
Total for 20 Workstations:			$85,358
DecRepeater 90T Concentrators	3	$1,050	$3,150
Total for Transmission System:			$3,150
Total for Digital Solution:			$120,379
Total Cost per User:			$6,019

Notes:

Although expensive, Compaq's SystemPro/XL was chosen as the server because it's a more even match for the MicroVAX. By contrast the same server based on Compaq's ProSignia 486DX2/66-1050, which would not give the same performance but which would do the job, costs $34,041.

COMPAQ/3COM/MICROSOFT

ITEM	QTY	RRP	ITEM TOTAL
SystemPro/XL Model 489/50-1050 (This unit uses a 1.05 GB Compaq SCSI hard disk, includes 16 MB RAM and a Compaq 10Base-T adaptor)	1	$24,293	$24,293
5.0 GB DAT drive	1	$4,101	$4,101
Microsoft LAN Manager 2.1 20 User	1	$4,620	$4,620
Microsoft SQL server unlimited user (required)	1	$12,345	$12,345
Total for Server:			$45,359
Prolinea 3/25ZS Model 84 (This includes 2 MB RAM, 84 MB Hard Disk and DOS 5.0 pre-installed)	1	$1,892	$1,892
Compaq 2 MB RAM expansion	1	$397	$397
Compaq 14" 1024 Colour Monitor	1	$842	$842
3Com EtherLink 16 TP (Based on price per NIC in packs of 5)	1	$638	$638
Microsoft Windows 3.1 & Mouse	1	$299	$299
Total per General Workstation:			$4,068
Total for 20 Workstations:			$81,360
LinkBuilder 10 BT Concentrator	2	$1,590	$3,180
Single Port Media Module (10Base-2)	2	$215	$430
Total for Transmission System:			$3,610
Total for C3M Solution:			$130,329
Total Cost per User:			$6,516

and a Digital MicroVAX have a lot in common, although each machine's ancestry clearly shows.

Digital has a range of machines in configurations that it designates specifically as servers. This means a configuration that is intended to run server-based application processes rather than directly support a large number of interactive users. At the low end of the scale is the MicroVAX 3100 that I have used for this comparison. The MicroVAX's desktop chassis can accommodate about 3 Gbytes of storage internally and another 5 Gbytes or so in an external expansion box of the same physical dimensions.

Roughly speaking the MicroVAX 3100 has about the same processor power as the high end SystemPros and, like the SystemPro, requires no special environmental consideration. Physically the MicroVAX 3100 is not much larger than a Compaq Deskpro M series. Digital engineers are used to thinking of floor space as a valuable commodity and as a result the MicroVAX fits easily in a rack mount cabinet. This contrasts with the SystemPro that must either sit on the floor or waste space in a rack mount cabinet.

Physical configuration aside, the most obvious difference between a VAX and a SystemPro is the degree of integration between operating systems and hardware. Digital has the luxury of designing both its hardware and its operating systems to function as a single unit. Compaq engineers have to ensure that a SystemPro will give good performance as a UNIX host, OS/2 server (or workstation), DOS machine, PICK host, not to mention a number of lesser evils. Conversely vendors like Microsoft, Novell, SCO et. al. cannot guarantee that the operating systems they produce will always be run on a SystemPro. They have to design their systems for the lowest common denominator. The result of this is that many of the hardware features available on a SystemPro, such as hardware diagnostics, are not necessarily available to an operating system and as a result across a network. This sort of functionality is important in the large LANs or WANs that are the platform for distributed systems. In such systems remote monitoring and management of all server functions is an absolute necessity.

A Note on Pricing

All prices given are recommended retail price inclusive of sales tax and were obtained directly from the vendors with the exception of 3Com NetBuilder II items. Due to time constraints NetBuilder II prices were obtained from a distributor's list. Where only RRP exclusive of sales tax was available costs have been calculated using percentages derived from vendor RRP excl. & inc. tax on similar products. Further, RRP from Compaq/3Com/Microsoft varies, unlike that from Digital. For example the RRP 3Com provided is up to 30% above the RRP (as opposed to street price) I got when I checked around Sydney.

Graeme Le Roux

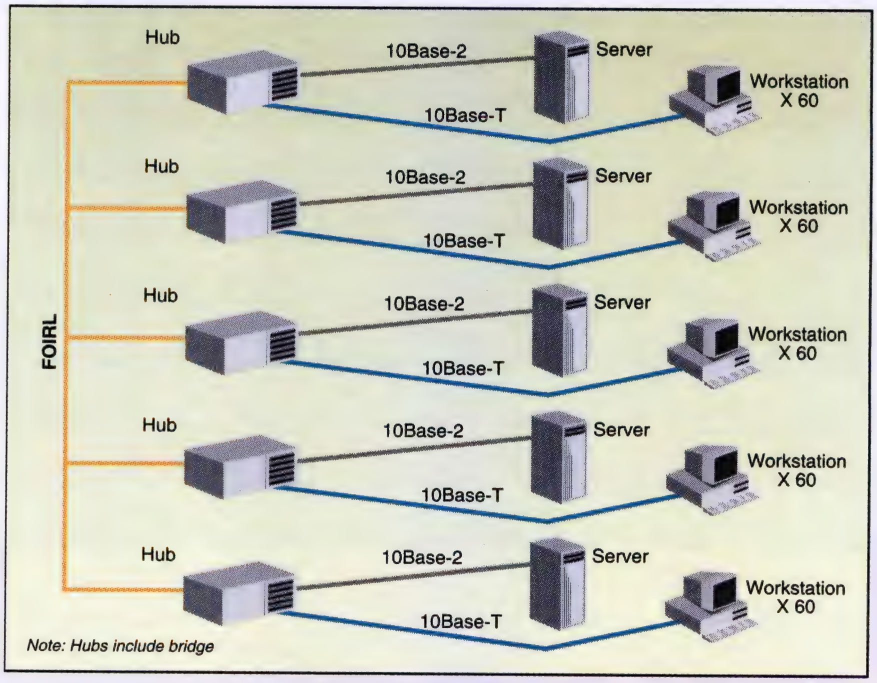
Network Management

Network *management*, i.e. the ability to manipulate objects such as user accounts, server configurations and hubs, is as equally important as network *monitoring*, or the ability to examine objects from a single point. Historically, management and monitoring of systems and applications have been separated from similar functions for hubs, routers, communications lines etc. This separation is blurring and as a result, provided you choose its elements with care, you will be able to mon-

Continued on page 88

Scenario #2: A Medium-Sized Company

This scenario was intended to simulate the requirements of a medium-sized company with a single large site. Since the network is to be a platform for the company's core business applications as well as all its 'bread and butter' applications I have written some degree of fault tolerance and management into the specification which follows.



Note: Hubs include bridge

'A 300 Workstation LAN spanning 5 floors of a 10 story building. Workstations are distributed roughly evenly — i.e. approximately 60 per floor.

It is required that each floor of the building be able to operate independently in case of a fault in the system backbone. This would include local (to the floor) printing. It may be assumed that all applications developed in-house will be designed with such contingencies in mind. It is required that all supplied applications will be similarly designed and/or configured. Expansion to other floors within the building and wide area links to intra- and intercity sites are planned over the next five years.

Other than expansion as per above, the increase of server disk capacity and possible memory upgrades to servers and workstations it is planned that the system remain 'as is' for a period of not less than four years and not more than six, though this maximum maybe extended.'

Base Requirements:

Workstations:
As per Scenario # 1

Administrative and Systems Development Workstations:
80486SX @ 33MHz or better
16 MB RAM minimum expandable to not less than 32 MB
300 MB hard disk minimum
VGA or better on 14" monitor
Mouse & 101 Key Keyboard
Microsoft DOS 5.0
Windows 3.1

All workstations must support the following applications or functional equivalents:

'In-house client server applications to be developed. Software tools, etc. required to develop in-house applications network administration, management & monitoring applications.'

General Servers:
'General' Servers that will support all users, store both data and applications and host client-server applications (to be developed in-house and deployed 6 to 12 months after a system tender is accepted). General Servers will be placed in locked, rack mount cabinets on each floor along with any required transmission system equipment. It may be assumed that each cabinet will be adequately ventilated 24 hours a day and will contain a single phase UPS that will provide AC out and low battery signals via an EIA-232 cable (signal compatibility with supplied equipment may be assumed) and which will guarantee a minimum of 5 minutes power between AC out and low battery warnings. All equipment inside the cabinet must automatically return to a known base state that will permit a remote in-band management station to monitor and/or initiate system restart immediately AC power is restored. Provision for such a management station to inhibit system restart in the event that AC power cannot be guaranteed for sufficient time to allow UPS batteries to recover charge would be favoured if available. Configuration is as per Scenario # 1, but with 2 GB of hard disk and no tape unit.

Administrative and Systems Development Servers:
All backup of general servers will be done across the network backbone by 'Administration' servers equipped with high capacity DAT units that will be situated in a network control centre (NCC — see below) within the building. These servers will also hold 'master' copies of all applications software. Such software will be down loaded to general servers and/or workstations as required. It is envisaged that administration and development teams will be accommodated on separate servers but will share resources such as printers. Configuration will be as per Scenario #1.

Network Control Centre:
It is required that the Network Control Centre (NCC) be able to perform the functions as listed below using as few management applications as possible. All management applications must coexist on a single hardware platform. It is preferred that this platform be an Administrative & Systems Development Workstation as specified above. Required functionality is as follows;

- Monitoring & Management of all hubs and concentrators on a port by port basis.
- Monitoring & Management of all Bridges, Routers, etc. on the network.
- Monitoring & Management of all printing functions.
- Monitoring & Management of all server functions including disk usage.
- Monitoring of basic workstation statistics (MAC Layer).
- Central control and monitoring of all access to the system.
- Ability to set user defined alerts for an arbitrary combination of events.
- Distribute and update of all applications software throughout the LAN.

Printers:
Each floor will require a minimum of a single, dual bin, 12 page per minute postscript capable laser printer with an envelope feeder. Throughput will be approximately 10,000 A4 pages per month. A single dot matrix printer capable of high quality output and a speed of not less than 200 ch/s in draft mode on 15" single part forms is also required on each floor. Throughput will be approximately 4,000 pages per month.
In addition some floors will require A4 plotters functionally equivalent to HP bin fed types.

Training:
The network will be administered and maintained by 3 full time support engineers. These SEs will also provide all user support. It may be assumed that these SEs will be fully qualified to support general PC software/hardware and will have at least 'literate user' level knowledge of at least one non-PC environment, however training for specific software and hardware products will be required.

Support & Service:
It is required that all hardware, software and services provided will be fully warranted for not less than 12 months. Such a warranty should provide a suitable mix of telephone and on-site support/service. Availability of post-warranty support/service contracts is also required.

DIGITAL			
ITEM	**QTY**	**RRP**	**ITEM TOTAL**
MicroVAX 3100 M30 as per scenario #1	1	$31,871	$31,871
Total per Administration Server:			$31,871
Total for 2 Administrative Servers:			$63,742
MicroVAX 3100 M30 as for Administration Server above	1	$31,871	$31,871
Additional 1.05 GB SCSI Hard Disk	1	$4,785	$4,785
Total per General Server:			$36,656
Total for 5 General Servers:			$183,280
DECpc 433DX-LP with 16 MB RAM, 367 MB Hard Disk, Mouse, SVGA 14" Monitor and DOS 5.0 plus Windows 3.1 pre-installed.	1	$7,905	$7,905
DEC EtherWORKS Turbo/TP adaptors	1	$551	$551
PathWORKS client licence	1	$287	$287
Total per Administrative Workstation:			$8,743
Total for 6 Administrative Workstations:			$52,460
DECpc 325SX-LP with 4 MB RAM, 105 MB Hard Disk, Mouse, SVGA 14" Monitor and DOS 5.0 plus Windows 3.1 pre-installed	1	$3,430	$3,430
DEC EtherWORKS Turbo/TP adaptors	1	$551	$551
PathWORKS client licence	1	$287	$287
Total per General Workstation:			$4,268
Total for General Workstations (5 floors X 60 per floor = 300):			$1,280,400
DecRepeater 90T Concentrators	8	$1,050	$8,400
DecBridge 90 FL (10BaseFL Local Bridge)	2	$4,460	$8,920
DecHub 90 Base Units	2	$1,050	$2,100
Total Per Floor:			$19,420
Total for Transmission System (5 floors):			$97,100
DECmcc Director, Media & Docs	1	$3,040	$3,040
DECmcc Notification Service, Media & Docs	1	$6,440	$6,440
HubWatch for VMS, Media & Docs	1	$4,400	$4,400
VAXStation 4000 VLC with 19" Colour Monitor	1	$20,910	$20,910
Total for LAN Management:			$34,790
Total for Digital Solution:			$1,711,772
Total Cost per User:			$5,706

COMPAQ/3COM/MICROSOFT			
ITEM	**QTY**	**RRP**	**ITEM TOTAL**
Systempro/XL Model 489/50-1050 as per scenario #1 but with unlimited LAN Manager	1	$40,739	$40,739
Microsoft LAN Manager 2.1 unlimited user	1	$11,565	$11,565
Total per Administration Server:			$52,304
Total for 2 Administrative Servers:			$104,608
Systempro/XL Model 489/50-1050 as above, but without tape unit	1	$48,203	$48,203
Compaq 1.05 GB SCSI Drive	1	$4,215	$4,215
Total per General Server:			$52,418
Total for 5 General Servers:			$262,090
Deskpro 4/33i Model M1 (This includes 4 MB RAM and DOS 5.0 pre-installed)	1	$4,212	$4,212
Compaq 12 MB RAM expansion	1	$2,211	$2,211
Compaq 340 MB Hard Disk	1	$3,300	$3,300
Compaq 14" 1024 Colour Monitor	1	$842	$842
3Com EtherLink 16 TP (in packs of 5)	1	$3,190	$3,190
Microsoft Windows 3.1 & Mouse	1	$299	$299
Total per Administrative Workstation:			$14,054
Total for 6 Administrative Workstations:			$84,324
Prolinea 3/25zs as per scenario #1	1	$4,068	$4,068
Total per General Workstation:			$4,068
Total for General Workstations (5 floors X 60 per floor = 300):			$1,220,400
LinkBuilder 10 BTi Hubs	2	$2,898	$5,796
LinkBuilder 10 BT Concentrators	4	$1,590	$6,360
Single Port Media Module (FOIRL)	2	$550	$1,100
Hub Expansion Cables	4	$85	$340
Total Per Floor:			$13,596
Total for 5 floors (excluding backbone):			$67,980
LinkBuilder ECS Fibre Optic Transceivers	10	$570	$5,700
LinkBuilder ECS/10 Chassis	1	$3,470	$3,470
LinkBuilder ECS Local Bridge Module	10	$5,085	$50,850
LinkBuilder ECS Management Module	1	$4,350	$4,350
ISOVIEW Core, Bridge & SNMP management software (Windows Based, runs on Administrative Workstation)	1	$6,815	$6,815
Admin Workstation running OS/2 V1.3.1 (required to manage LAN Manager)	1	$11,271	$11,271
Total for Transmission System Backbone:			$82,456
Total for C3M Solution:			$1,821,858
Total Cost per User:			$6,073

Notes:

1. The DEC 90 series devices can be used standalone (as per scenario #1) or as modules in a DecHub 90 (8 per hub). Prices differ for each configuration. Modules are interconnected via Ethernet on the hub.
2. It turned out to be cheaper to arrange a star configuration using 3Com components rather than the classic Ethernet backbone arrangement used with Digital components. This star configuration gives much higher effective backbone bandwidth, however this is overkill in this application since most traffic is local to each floor. Had higher backbone bandwidth been required there are a number of other Digital solutions.
3. It is assumed that three Administrators and three Software Developers will support this LAN. Therefore six of the 300 workstations will be 'Administrative Workstations.'

Scenario #3: A Wide Area Network

This scenario is intended to simulate a larger WAN. It is a combination of #2 and #3 before and reads as follows.

'A wide area network composed of one LAN as per Scenario #2 in the capital city of each State and Territory — i.e. total of eight. Each capital will be wholly responsible for up to 15 'dark sites' throughout a State. These 'dark sites' will be LANs as per Scenario #1. They will not have any technical expertise or in-house support capability.

Backup tapes will be changed locally, however status monitoring and scheduling of such backups will be done remotely. These local backups will be primarily for non-critical data and a last resort for critical data. Backup of all critical system data will occur across the network.

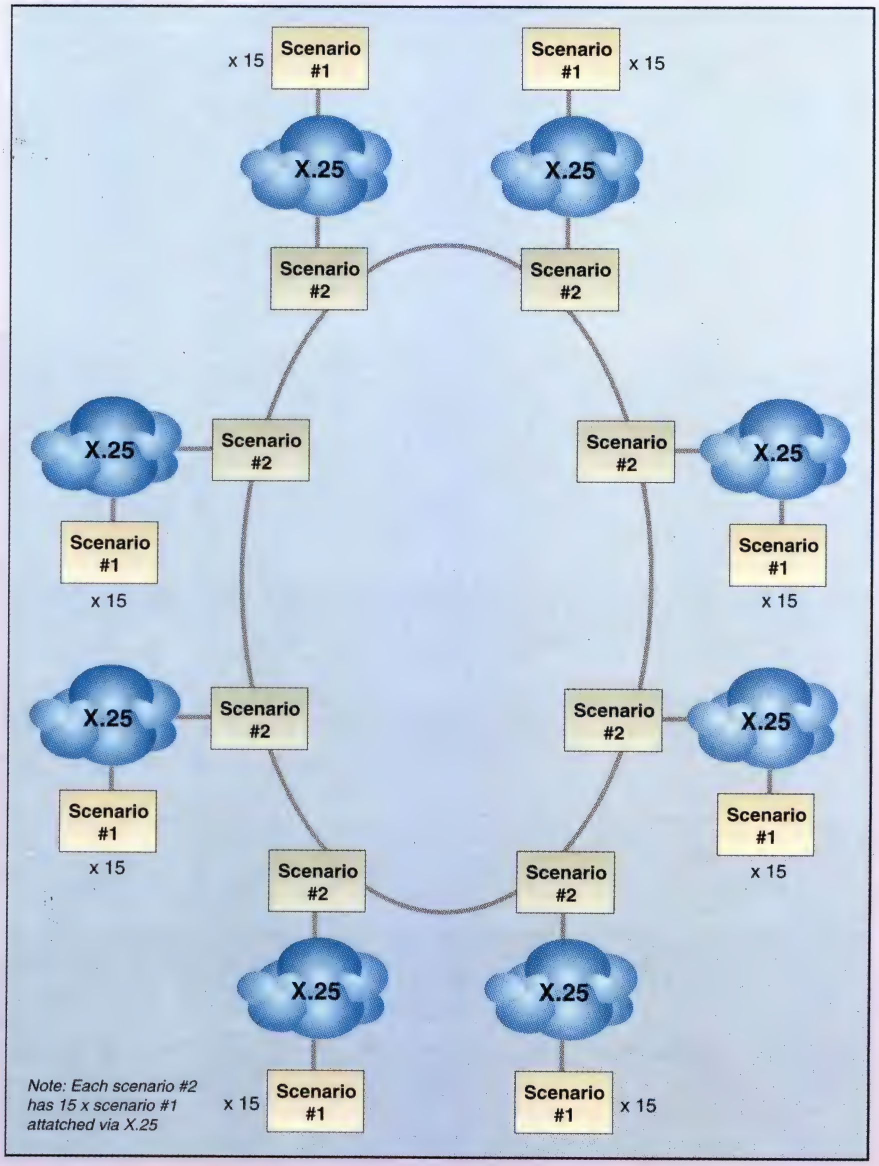
All file server, transmission systems and communications equipment will be housed in a locked rack mount cabinet as per the building floors in Scenario #2.

All capital city wide area network hubs are to be interlinked by point-to-point leased lines of not less than 64Kbps bandwidth in a fault tolerant configuration. This means that all capital city WAN hubs must have routing capability.

State-wide 'dark sites' will be linked to their State's WAN hub via X.25. This will permit them to link to any state hub in case of a network fault. It must be assumed that these small sites will require low bandwidth direct communication with each other.'

Notes:

In the case of the Digital wide area network solution a star configuration turned out to be more cost effective. As a result of this one 'main building' has a VAXStation 4000 Model 60 rather than a VLC as a management console. This unit is capable of monitoring and management of the whole WAN, however other management consoles have been retained for operational reasons.



Note: Each scenario #2 has 15 x scenario #1 attatched via X.25

From page 85

itor and manage your entire system from a single network station. In this comparison I've selected a VAXStation as the management/monitoring 'console' for the Digital environment and 3Com's ISOVIEW software (which runs under Windows) for C3M.

Unfortunately some network management functions in a LAN Manager environment require an OS/2 workstation (the server can be used) so the C3M management solutions include a machine dedicated to this. A little untidy perhaps, but functional.

To build and develop distributed systems requires a sophisticated development environment. Both Microsoft and Digital are in the business of writing software and both have customers who develop software systems. The main difference is that most of Digital's customers develop systems of one form or another. This is the nature of traditional environments. Digital has to be ready to support this. The result is that minicomputer vendors, by the nature of their business, have a far more sophisticated software support infrastructure than the PC industry. To its credit Microsoft has realised this, as have other PC vendors in the PC systems area, and is trying to provide more comprehensive and sophisticated support options to its customers but it, and the rest of the PC industry, has a long way to go.

One area of software product where both Digital and Microsoft are broadly equal is that of tools such as compilers, development kits, etc. I checked Microsoft's product list in this area against Digital's VMS software source book (ignoring products that did not come from Digital, though many have Australian agents listed) and found a functionally equivalent product in almost every case. Where one company does not have a competing product the other has a number of products that provide a similar function.

For example, the ancillary tools associated with Digital's VAX Datatrieve provide a rough equivalent for Visual Basic with its SQL tool kit for creating database front ends. On the other hand Digital produces a greater variety of compilers than Microsoft. This broad functional equivalence is also evident in base applications. Microsoft produces Word for Windows while Digital produces DECWrite. DECWrite has most of Word's functions and runs under Microsoft Windows, Ultrix, VMS (on Digital's POSIX-compliant DECWindows terminals) and several other platforms.

For reasons of space I have ignored the option of Windowing terminals and the processing power of VAXs as a comparison to PCs on desk tops. However in more cases

DIGITAL			
ITEM	QTY	RRP	ITEM TOTAL
MicroVAX 3100 M30 as per scen. #1	1	$31,871	$31,871
Total per Administrative Server:			$31,871
Total for Administrative Servers (2 per building X 8 buildings):			$509,936
MicroVAX 3100 M30 as per scen. #2	1	$36,656	$36,656
Total per General Server:			$36,656
Total for General Servers (5 per building X 8 buildings):			$1,466,240
MicroVAX 3100 M30 as per Scen. #1	1	$31,871	$31,871
EIA-232 Sync Controller, Licence, Media & Docs	1	$3,610	$3,610
Total per Remote Site Server:			$35,481
Total for Remote Site Servers (15 per building X 8 buildings):			$4,257,720
DECpc 433DX-LP as per scenario #2	1	$8,743	$8,743
Total per Administrative Workstation:			$8,743
Total for Administrative Workstations (6 per Building X 8 Buildings):			$419,664
DECpc 325SX-LP as per scenario #2	1	$4,268	$4,268
Total per General Workstation:			$4,268
Total for General Workstations (294 per Building X 8 Buildings = 2,352; plus 20 per Remote Site X 120 Remote Sites = 2,400):			$20,281,536
Transmission System per building as per scenario #2	8	$97,100	$776,800
Transmission System per remote site as per scenario #1	120	$3,150	$378,000
DecHub 90 Base Units	80	$1,050	$84,000
Total for Transmission System:			$1,238,800
VAXStation 4000 VLC management station as per scenario # 2	7	$34,790	$243,530
DECNIS 500 DNSDB-BC (provides X.25 port, 1 port of point to point and one LAN port. Includes routing software licences)	7	$15,968	$111,776
HubWatch for VMS, Media & Docs	1	$4,400	$4,400
VAXStation 4000 Model 60, with 40 MB RAM, 852 MB Hard Disk and 19" Colour Monitor	1	$36,502	$36,502
DECNIS 500 DNSDG-BC (provides X.25 port, 7 port of point to point and one LAN port. Includes routing software licences)	1	22,300	22,300
Total for LAN Management:			$436,925
Total for Digital Solution:			$28,610,821
Total Cost per User:			$5,961

COMPAQ/3COM/MICROSOFT			
ITEM	QTY	RRP	ITEM TOTAL
SystemPro/XL Model 489/50-1050 as per scenario # 2	1	$52,304	$52,304
Total per Administrative Server:			$52,304
Total for Administrative Servers (2 per building X 8 buildings):			$836,864
Systempro/XL Model 489/50-1050 as per scenario # 2	1	$52,418	$52,418
Total per General Server:			$52,418
Total for General Servers (5 per building X 8 buildings):			$2,096,720
Systempro/XL Model 489/50-1050 as per scenario # 1	1	$45,359	$45,359
Total per Remote Site Server:			$45,359
Total for Remote Site Servers (15 per building X 8 buildings):			5,443,080
Prolinea 3/25zs as per scenario #1	1	$4,068	$4,068
Total per General Workstation:			$4,068
Total for General Workstations (294 per Building X 8 Buildings = 2,352; plus 20 per Remote Site X 120 Remote Sites = 2,400):			$19,331,136
Deskpro 4/33i as per scenario # 2	1	$14,054	$14,054
Total per Administrative Workstation:			$14,054
Total for Administrative Workstations (6 per Building X 8 Buildings):			$674,592
Transmission System (including backbone) as per scenario # 2	8	$150,436	$1,203,488
Transmission System as per scenario # 1	120	$3,610	$433,200
Wide Area Additions: Main Buildings			
NetBuilder II (4 Slot chassis)	8	$5,694	$45,554
EtherLink TP Transceiver	8	$210	$1,680
NetBuilder II Ethernet Module	8	$2,109	$16,872
NetBuilder II High Speed Serial Modules	16	$2,702	$43,229
NetBuilder II Software V5.0 + X.25	8	$2,330	$18,640
Wide Area Additions: Remote Sites			
NetBuilder II (4 Slot chassis)	120	$5,694	$683,316
EtherLink TP Transceiver	120	$210	$25,200
NetBuilder II Ethernet Module	120	$2,109	$253,080
NetBuilder II High Speed Serial Modules	120	$2,702	$324,216
NetBuilder II Software V5.0 + X.25	120	$2,330	$279,600
Total for Transmission System:			$3,328,075
Total for C3M Solution:			$31,710,467
Total Cost per User:			$6,606

then you might think this is now a real option for a distributed system or even bread and butter applications.

Limits of Comparison

There are a number of limitations in a direct comparison between PC and traditional systems. Digital (and other minicomputer vendors) do not use the same benchmarks as the PC industry and in any case for a server the throughput of its subsystems — disks, network interfaces, etc. — is as important as simple processor throughput. One of the reasons I choose Digital and Compaq was that the level of engineering quality in these areas is roughly equivalent.

Roughly speaking the general performance of a low end MicroVAX is equivalent to that of a SystemPro/XL. I emphasise the word 'roughly' because such a comparison involves many architectural issues that are simply outside the scope of this article.

One obvious difference between the two is that of disk subsystems. Digital's standard

Cost Summary

	DIGITAL	C3M
SCENARIO #1		
Total Cost	$120,379	$130,329
Cost per User	$6,019	$6,516
SCENARIO #2		
Total Cost	$1,711,742	$1,821,858
Cost per User	$5,706	$6,073
Total Cost for System Management	$87,250	$106,760
Percentage Cost of System Management	5.1%	5.9%
Cost of Management per User	$291	$341
SCENARIO #3		
Total Cost	$28,610,821	$31,710,467
Cost per User	$5,961	$6,606
Total Cost for System Management	$856,589	$854,080
Percentage Cost of System Management	3%	2.7%
Cost of Management per User	$178	$171

configurations use its own high reliability SCSI units, while Compaq uses either an array of IDE drives or SCSI units. In some applications drive arrays provide better performance than a single unit. Arrays also cost more, especially if configured for fault tolerance. Digital has a number of options for its VAX line that use arrays and/or cluster technology but they are more costly than standard configurations. As a result of this I have chosen to compare only Digital's and Compaq's SCSI models in this article.

Another reason for choosing Compaq as opposed to lower cost machines is that I am *specifically* looking at platforms for distributed systems. This in turn requires a platform capable of sustained operation at 100% duty cycle — that is round the clock operation. I have serious reservations about the ability of many 'PC Servers' to sustain such operations.

Another major difference in this comparison is the way in which Microsoft and Digital licence software. Digital uses client-based licences while Microsoft currently uses a package (or server) based scheme. This means that the 'server' software — Network Application Support (NAS) and Rdb (which 'speaks' SQL) — in a Digital host is effectively 'unlimited.' To use it with a Digital client you buy the required number of 'client' licences — this is the case with PathWORKS. You can also write your own front end and use it without limit — this is the case with Rdb.

On the other hand Microsoft's LAN Manager and SQL have a proscribed number of licences (10 is the base). This means only a fixed number of concurrent users may use a server, unless you buy an 'unlimited' licence. The result is that Digital software is cheaper until you reach about 30 users or so. However this situation may change when Microsoft moves to client-based licensing, which it is planning to do well within 12 months.

Another aspect of this is that licences and package bundles offer differing features. For example, Digital's NAS offers the equivalent of the server elements of an unlimited LAN Manager package but also supports Macintosh clients along with several other things that require separate products from Microsoft. On the other hand NAS does not provide client licences, you buy those separately as discussed above.

While on the subject of software related costs I must also note that Digital system software is shipped either on tape or CD and you buy media and manuals separately from licences. This means that for 10 MicroVAXs (which include a base OpenVMS licence) you need only buy the number of manual sets and software media you require — perhaps only one set. In Microsoft LANd you buy 10 complete sets of software and install each from floppies. This is costly in turns of both capital and time.

My Three Networks

The three networks described in the preceding pages illuminate basic differences in between C3M and Digital. However there are a few points that need to be highlighted. Firstly, I have ignored the cost of changing from an existing system to either solution because this depends on just what you have and how you are using it. The question is site specific. I have ignored the cost of laying cables, installing patch panels, wall sockets etc. for the same reason.

I have assumed the use of a strict single drop cable system using 10Base-T to the desktop and either 10Base-2 (Scenario #1 on page 84), 10Base-F or FOIRL (Scenarios #2 and #3 on starting on pages 86 and 88 respectively) as a backbone. My reason for this is that the resultant costs for hubs, etc. should be roughly comparable to a Token Ring solution (or a solution using, for example, Digital's VXT type Windowing terminals). Adaptor costs will differ radically. Another of my base assumptions is that in all cases a client/server application is likely and that in Scenarios #2 and #3 it will be distributed. I have assumed that this will be a database application because this allows me to directly contrast Microsoft's SQL server with Digital's Rdb.

Each scenario is couched in terms of PCs, however I added the line 'Functionally Equivalent GUI-based solutions will be considered' to the specification as presented to the vendors. This probably would not happen in real life, but I'm not at all certain that it should not. These specifications as presented to vendors also included a list of Microsoft Windows applications which workstations had to be capable of running. I've also specified printing in terms of pages per month. All printer manufacturers can supply duty cycle figures, however in the PC environment printers are usually sold on 'pages per minute' and such things as the number of available fonts. This approach does not necessarily result in the acquisition of a 'reliable' printer.

Summary & Conclusions

As you can see from the figures in the Table above the 'traditional' solution comes out on top of the 'PC solution' in every case. But, I strongly suspect that this gross difference would disappear on the street. What is significant however is that cost per user for all scenarios varies little in both cases. Similarly, the cost of management as a percentage of system cost is roughly even. What does distance Digital from C3M is the support infrastructure. Digital was able to quote a base monthly charge for warranty equivalent support (i.e. on-site hardware and telephone software) for each element of its solutions. These charges are roughly 10-12% of RRP. With variations for location, hours of contract and required response times this support is available anywhere in Australia around the clock (base warranty is business hours only). Support for PCs is fragmented and dependant on geography due to the nature of the channel.

Put simply you can build a distributed system on either a PC or a traditional platform. You will have to do a great deal more leg work in building the PC solution and your on-going support cost will be higher since outsourcing will be more difficult. Whatever decision you make you will do yourself a disservice by ignoring the options presented by traditional vendors.

Graeme Le Roux is a Director of NSW-based Moresdawn Pty Ltd and specialises in local area networks consulting services. He thanks the staff of Digital, Microsoft, Compaq and 3Com for their time and effort in providing the information for this article. For further information Digital Equipment Corporation can be contacted on 008 021 246 while Compaq, 3Com and Microsoft information can be obtained from any authorised dealer.

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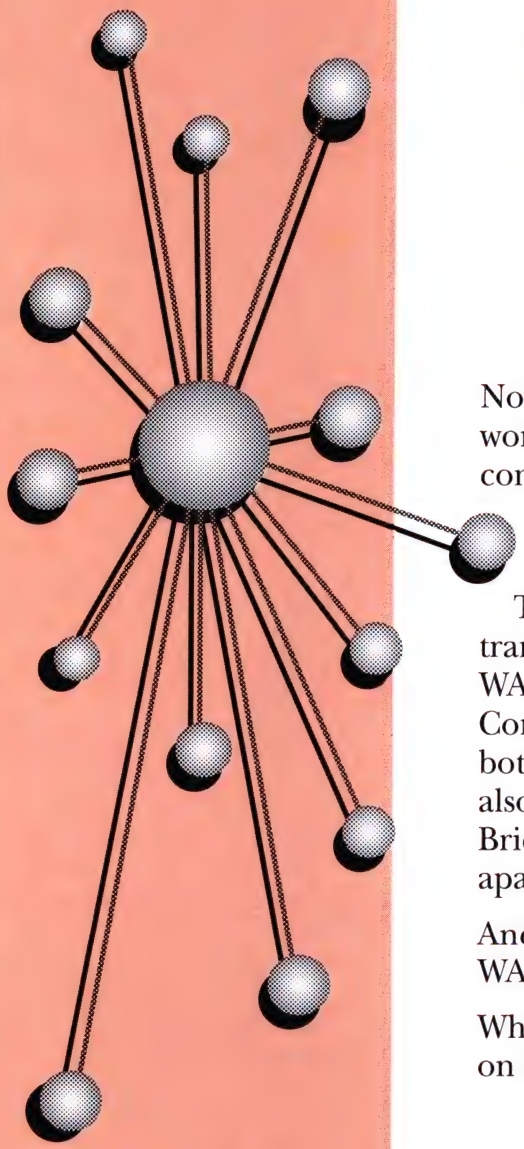

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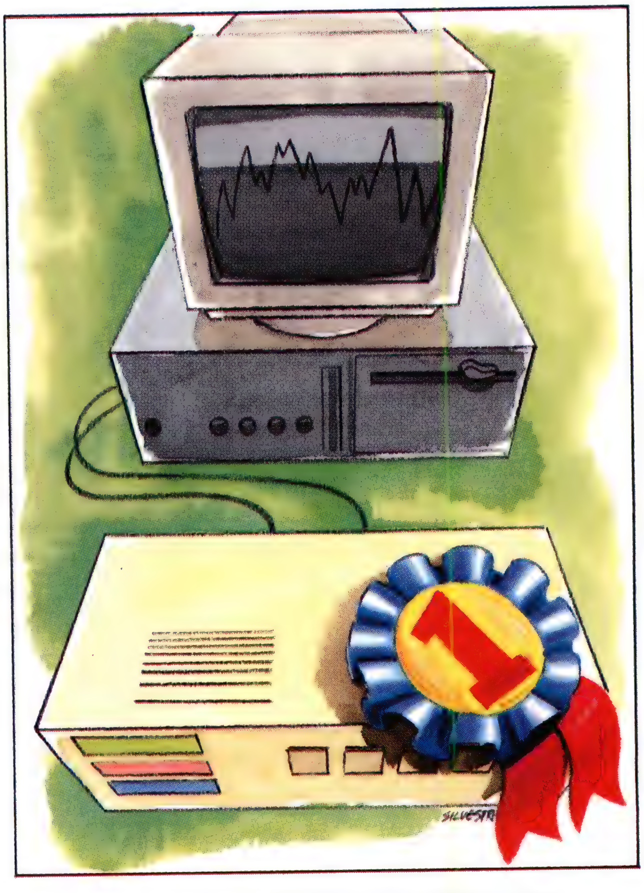
The Improvers: Remote Token Ring Bridges

As the latest round of tests by the Data Comm Test Lab show, remote Token Ring bridge performance is improving. However, vendors must still address the problem of congestion.

When the US-based Data Comm Test Lab took a look at remote Token Ring bridges last year, it discovered some alarming discrepancies between vendor claims and product performance. The findings of this year's test of remote Token Ring bridges aren't nearly as explosive — good news for all concerned. Most of the vendors that did poorly last time out have made significant gains in throughput, picking up 1,000 to 2,000 packets per second. And just about every bridge/router could use all the bandwidth offered by high speed lines when working with the large packets typically used for file transfers. Ironically enough, the best performances (this year and last) were achieved by what are often considered low-end boxes: IBM compatibles with a limited number of ports and no routing. For the second year running, Olicom's Remote Bridge 16/4 (distributed in Australia by Force Technology) outdistanced the competition, and its OS/2 version, which can be run in a server, proved just as much a speed demon, earning its maker a Tester's Choice award for unparalleled packet processing. Speed is just part of the picture. Now that performance has reached acceptable levels, vendors will have to turn their attention to congestion, a sure killer of SNA sessions. Unfortunately, only seven of the vendors evaluated furnish even data compression, the simplest solution to this problem.

Among bridge vendors, Crosscomm (represented by Scitec Communications) is clearly out in front in its commitment to boosting performance over the WAN, which earned it a Tester's Choice award. The company has equipped its ILAN bridge/routers with NetBIOS name caching and protocol-independent routing. Other vendors would be wise to follow Crosscomm's lead.

All in all, the products tested this year deliver a wider range of features and functions. Vendors of lower-end bridges like Netronix (represented in Australia by Lancon) have added routing support for the most common protocols (IP and IPX), while bridge/router makers Cisco Systems and Proteon are turning out scaled-down versions of their high-end boxes to be deployed at remote locations. What's more, some particularly nettlesome problems with setup and configuration are finally starting to be addressed. These changes bode well for the industry and indicate some of the latest trends in product development.



There also are more products out there to choose from, reflecting the increased demand that's resulted from a greater reliance on LAN internetworks for traditional SNA applications and the growing number of connections between departmental LANs. This time around, the Lab tested 19 bridges from 18 vendors (not all of whom are represented in Australia), up from 14 last year. RAD Network Devices (RND) participated last time out but declined this year's invitation, as did Network Equipment Technologies (NET). Bridges from Ungermann-Bass were not evaluated, since the company's new 16Mbps Token Ring device is OEM'd from Advanced Computer Communications (ACC, also distributed by ADE in Australia). No OEM products are tested.

A newcomer (and impressive) is IBM's long-awaited 6611 bridge/ router which is being released in Australia in early 1993. The Lab was supplied a beta version of this box for the industry's first

Selected Vendors of Remote Token Ring Bridges

VENDOR	PRODUCT	PLATFORM	VERSION	TOKEN RING CHIP SET	TOKEN RING MICROCODE	WAN PROTOCOL
Advanced Computer Communications ADE (03) 543 2677 or Ungermann-Bass (03) 696 2006	ACS 4200	Proprietary, 25MHz 68030	5	Texas Instruments (TI)	TI TurboMAC	HDLC, PPP, LAPB
Andrew Australia (03) 357 9111	Bridgeport 7412/416	Proprietary, 10MHz 80186	1.09	TI	TI TurboMAC	HDLC
Ascom Timeplex (02) 957 1660	Time/LAN 100 Router*bridge	Proprietary, 33MHz 80386	3.1	TI	TI TurboMAC	HDLC, PPP, LAPB
Cisco Systems (02) 957 4944	MGS	Proprietary, 25MHz 68040	9.0 (1.3)	TI	Madge FastMAC	HDLC, PPP, IP
Crosscomm† Scitec (02) 428 9555	ILAN	Proprietary, 33MHz 80386	5.02	TI	TI TurboMAC+	HDLC, SDLC
Hewlett-Packard (03) 272 2895	HP Router TR	Proprietary, 25MHz 68020	5.74	TI	Madge FastMAC	HDLC, PPP
IBM 132 426	IBM Remote Bridge	Off-the-shelf PC, (25MHz 80386 recommended)	2.21	IBM	IBM	SDLC
	6611 Model 140	Proprietary, based on RS-6000	1.0 Beta	IBM	IBM	PPP
Netronix Lancon (02) 899 3029	Tokenmaster 4000	Proprietary, 12MHz 80286	3.3	IBM	IBM	LAPB
Newbridge Networks Datacraft (03) 727 9111	Integral Token Ring Bridge	Proprietary 20MHz 68020	L211-H2-01	TI	TI TurboMAC	HDLC, PPP
Olicom† Force Technology (02) 971 1000	Remote Bridge 16/4	Off-the-shelf PC	2.3	TI	Olicom	HDLC
Proteon (02) 412 0050	CNX 500	Proprietary, 25MHz AMD 29000	11	TI	TI TurboMAC	SDLC, PPP
3Com (02) 959 3020	NetBuider TR	Proprietary, 16MHz 68020	5.1	TI	TI TurboMAC+	HDLC, PPP
Wellfleet Communications JNA (02) 417 6177	Link Node	Proprietary, 32MHz 68030	5.74	TI	Madge FastMAC	HDLC, PPP

HDLC = High-Level Data Link Control
LAPB = Link Access Procedure-Balanced
LNM = LAN Network Manager
PPP = Point-to-Point Protocol
SDLC = Synchronous Data Link Control
SRT = Source Routing Transparent
† **Testers Choice**

in-depth evaluation of its bridging capabilities. Now that this round of tests is complete, it's clear that the 6611 defines state-of-the-art in some areas that other vendors have been all too willing to overlook. The router delivers the most advanced configuration and management capabilities of any product tested, advanced diagnostics, and a bulletproof maintenance system (see 'IBM's 6611: A Router to Reckon With' on page 100). IBM has apparently applied the same standards to its router that it uses for management and maintenance on its mainframes. Whether the rest of the industry will get the message remains to be seen. The Lab also tested Version 2.21 of IBM's Remote Token Ring Bridge Program.

Congested Arteries

Despite all of the Lab's favourable findings, though, it's not time to sound the all-clear signal. Vendors, as noted, have yet to come up with a way to ensure that their bridges always get critical data to its destination, especially when low-speed WAN lines become congested. The ideal remote Token Ring bridge would be a plug-and-play box that network managers could deploy without worry and end-users would never know is present (in other words, a commodity item). If it sounds too good to be true, the Lab's recent test of local Token Ring bridges demonstrated that there are devices that meet such specifications (see 'Local Token Ring Bridges: Speed and Simplicity,' *Australian Communications,* November 1992).

But local bridges have bandwidth to burn. The bandwidth available across the wide area is far more restricted. And even though high speed links are common on corporate backbones, today's downsized, right-sized, and at times down-and-out-sized business climate makes low speed lines far easier to cost-justify to smaller, remote sites.

With such constrained bandwidth, congestion is inevitable. And congestion kills SNA sessions (delays can cause timers to expire, thus crashing sessions; a 3174 communications controller, for instance, will disconnect from a mainframe after only 12 seconds). It may be caused by legal traffic (such as large file transfers) or by an anomaly (such as excessive broadcasts). Either way, it's deadly. The easiest way to avoid congestion, short of buying more bandwidth, is with data compression. Surprisingly, less than half of the vendors tested have taken this tack. SNA and file transfer traffic tend to be highly compressible. Network managers might not enjoy the 4:1 compression ratios vendors sometimes advertise, but even 2:1 is a godsend. At higher speeds, most vendors recommend turning compression off, since the time it takes to compress data actually offsets any benefits gained from using it. One further point: Check whether a vendor's compression is true compression or simply null or repeated character suppression. Not all compression is created equal.

The lack of data compression doesn't mean that vendors are unaware of the congestion problem, or that they are ignoring it. Many have chosen to implement proprietary techniques for cutting down on the amount of data crossing the wide area. Crosscomm, as mentioned, uses NetBIOS name caching to cut down on NetBIOS broadcasts. Its

MAXIMUM WAN PORTS	WAN SPEED (Mbps)	DATA COMPRESSION	SRT	LNM/SNMP
4	2.048	Yes	No	No/Yes
1	2.048	Yes	Yes	Yes/No
12	2.048	No	Yes	No/Yes
10	4	No	Yes	Yes/Yes
5	2.048	Yes	Yes	Yes/Yes
2	2.048	No	Yes	No/Yes
1	2.048	No	No	Yes/No
12 (on 6 cards)	2.048	No	No	No/Yes
1	2.048	Yes	No	Yes/Yes
30	2.048	No	No	No/Yes
1	2.048	Yes	No	Yes/No
6	2.048	No	Yes	Yes/Yes
2	2.048	No	No	No/Yes
16	6	No	No	No/Yes

protocol-independent routing (as the name suggests) makes it possible to route protocols that normally can only be bridged. With routing, data stands a better chance of getting to its destination. Cisco's Proxy Explorer cuts down on the number of source route explorer packets travelling over a wide area network.

Express Queuing from ACC attempts to guarantee that individual interactive sessions are not overwhelmed by a barrage of less crucial data. The technique monitors session pairs running across a WAN and applies a fair-share queuing algorithm to make certain that none of them grabs an inordinate amount of WAN bandwidth.

Other proprietary schemes have been implemented, but as yet no vendor offers empirical evidence to tip the scales in its favour. The Lab hopes to give many of these proprietary approaches an engineering-level evaluation in upcoming tests. At the same time, it decided not to test data compression again this year, since doing so would probably do no more than duplicate last year's test results. As long as congestion remains a problem, though, remote Token Ring bridges can't reliably support mission-critical applications. That's not just bad news for vendors; it's also likely to come as an unpleasant surprise to companies committed to LAN internetworks for client/server applications, the same organisations buying and deploying remote bridge/routers. Once the boxes are deployed, the idea is to transfer SNA terminal emulation applications to the new network, where they will run alongside LAN applications. It sounds good, but many companies are going to discover that as a result of congestion from LAN traffic, their new internetworks can't support SNA applications as reliably as their tried-and-true 9.6-Kbps cluster controller installations. From the outside, it may look as if an organisation has made the move to LAN interconnect, but the reality is that the requisite network infrastructure for client/server applications is still missing.

Platforms in Particular

Remote Token Ring bridges can be implemented as off-the-shelf PCs or as so-called closed-box PCs (these use Intel processors and the ISA bus but can only run the bridge program). They also can be rack-mounted proprietary hardware, integrated into a hub, or built onto an add-in card for a multiplexer (see table). This year, the Lab for the first time worked with a bridge that runs in a network file server — Olicom's Remote Bridge 16/4. Olicom has ported its DOS-based bridge software to OS/2. The new software runs as a 16-bit OS/2 application under OS/2 1.3. (A version for OS/2 2.0 is on the way).

When it comes to linking satellite offices, Olicom's server approach may be more efficient than low-end routers. Running the bridge in the same PC as the LAN operating system should cut down on hardware costs and maintenance.

This is the second year that the Lab worked with a bridge integrated into a multiplexer — the Integral Token Ring Bridge from Newbridge Networks (distributed in Australia by Datacraft). While it completed all the tests, the Newbridge box was by far the most difficult to configure. In last year's tests, the Lab evaluated NET's mux-based LWX bridge/router and found it turned in lower-than-average performance. Obviously, mux vendors have a lot of work to do before their products can be considered competitive with standalone bridges.

The trend in PC bridges is toward closed boxes. This may be more a matter of psychology than performance: Vendors seem to feel that customers are uncomfortable relying on off-the-shelf PCs when it comes to moving mission-critical data over the corporate backbone. Another trend in PC bridges can be seen in the move to more powerful processors. Last year 12MHz 80286s were standard issue in off-the-shelf units and closed boxes. This time around, 25- and 33MHz 80386s were much more in evidence. A parallel shift is taking place in rack-mounted gear: Last year's 16MHz 68020s are giving way to 25- and 33MHz 68030s.

Processor upgrades were no doubt responsible in part for some of this year's performance improvements. Still, the Lab doesn't believe that CPU power is a good criterion to use when selecting a bridge, since in last year's test even the slower CPUs didn't appear to be overloaded. Other components, particularly the Token Ring chip set, and the efficiency of the software drivers contribute far more to performance.

Chip Sets, Management

Last year's Lab test of remote Token Ring bridges revealed that the two most commonly used Token Ring interfaces and drivers — either from Texas Instruments (TI) or from IBM — limit LAN/WAN throughput to less than half the bandwidth of a full-duplex high speed line: Roughly 6,000 packets per second (pps) for bi-directional traffic with 64 byte packets. It was also apparent that the few vendors that had optimised the standard drivers that came with the TI and IBM chip

Vendor Roundup

Advanced Computer Communications
ACC was one of the first vendors to build a reasonably priced box that's easy to use and handles both bridging and routing. The only feature missing is LAN Network Manager. ACC is very heavily involved in the industry-wide effort to formulate RFC 1231, which defines the use of SNMP to manage Token Rings.

Andrew Australia
Andrew specialises in IBM-compatible bridges. It intends to deliver a windows-based version of its configuration program and has recently announced a RISC-based bridge that will support frame relay and SNMP.

Ascom Timeplex
Although best known for its high speed multiplexer, Ascom Timeplex has built a good following among large customers since getting into the bridge/router business this year. The company plans to deliver a low-end router in the first quarter of 1993.

Cisco Systems
By far the most successful bridge/router vendor, Cisco is best known for its high-end multiprotocol routers. Still, the company has actually shipped more two-port IGS and IGS-TR routers. Cisco just announced a new line of low-end routers, the 3000 and 4000 Series. It has added support for LNM.

Crosscomm
Many bridge/router vendors have their roots in TCP/IP and Ethernet; Crosscomm alone was founded to serve the IBM market. Its ILAN is one of the easier boxes to configure. Crosscomm recently announced the ILAN Junior for small, remote sites. Crosscomm was given the Tester's Choice for showing the most serious commitment to boosting performance over WANs, ensuring the integrity of SNA sessions.

Hewlett-Packard
HP is new to the Token Ring market. Users of HP's Ethertwist line of hubs and bridges will like its Router TR, which fits neatly into the racks HP sells for its other Ethertwist products. All HP's routers are based on Wellfleet software.

IBM
The lab checked out two IBM products: Version 2.21 of its reliable PC bridge and the new 6611 router. The former has been enhanced significantly; the later (tested in beta) sets the standard for configuration and maintenance.

Netronix
Last year, Netronix's IBM-compatible bridge was a top performer, and this time the Tokenmaster 4000 did even better. SNMP is new to the box. The company has now announced IP and IPX routing and a beefed-up Tokenmaster 5000, with more ports.

Newbridge Networks
Newbridge is best known for its high speed muxes, and like several of its competitors it's selling bridges that can be integrated into its multiplexers. Although the bridge worked as advertised, it's very difficult to configure.

Olicom
Olicom, the number two vendor of Token Ring adaptors in Europe after IBM, has clearly spent considerable time optimising its Token Ring driver software. Its product continues to be a screamer, and the impressive results achieved by the OS/2 version are particularly noteworthy since the software makes it possible to implement bridging from a server. Olicom was given a Tester's Choice for speed. It's Remote Bridge 16/4 and server-based OS/2 bridge program turned in blazing performance numbers with small and large packets at all speeds.

Proteon
Proteon specialises in Token Ring products. Although the lion's share of its business comes from adaptor cards, the company is extending its offerings at a healthy pace. Last year's p4100+, an ISA-bus bridge, has been joined by the RISC-based CNX-500 and the low-end DNX 300. Look for the latter to be offered as an add-in card for Proteon Series 90 Token Ring hub.

3Com
In addition to NetBuilder, 3Com sells a complete line of hubs and Ethernet bridges and routers. It recently acquired BICC Networks' product line to supplement its own hubs. 3Com is known for its excellent worldwide service and support. The company has plotted an aggressive SNA strategy; it's one of the first vendors to license IBM's APPN Network Node.

Wellfleet Communications
Wellfleet is extremely successful as a vendor of high-end products for large, multiprotocol networks. Its latest product, the just-shipped Backbone Node, is even higher-end, with capabilities like fault tolerance.

sets were able to boost bridge throughput over a high speed line by as much as 50%.

This year, almost all vendors have taken steps to optimise their drivers. Some have written custom code. Most have upgraded their drivers to TI's new TurboMAC or TurboMAC+, or FastMAC from Madge Networks, which works with TI's chips.

By next year, the Lab expects that new drivers and chip sets will make possible even greater gains in performance. Slated for arrival are IBM's Tropic chip set, which will be marketed by National Semiconductor and Token Ring chips from Standard Microsystems. At the least, more vendors will help bring prices down.

High-end routers, as well as some standalone bridges, can still be a nightmare to configure. The sad truth is that the largest router vendors, Cisco, Proteon and Wellfleet have made no enhancements to their interfaces since last year's tests.

In contrast, Crosscomm has introduced a configuration and network management program based on HP's Openview GUI, while IBM, Persoft, and 3Com have taken special care to make configuration far easier. Andrew and Netronix have already integrated menu-based configuration programs into their products, and both vendors say they plan to make them even easier to use by adding Windows or OS/2.

Last time, bridge/router vendors were clearly divided when it came to net management: They offered either SNMP or IBM LAN Network Manager (seven supported the former; five, the latter). No one delivered both. This year, Cisco, Crosscomm, Microcom, and Netronix support both. The Lab expects the number of vendors delivering both to increase dramatically in coming months. That's good news: Both are market requirements and offer complementary functions. SNMP's strong suit is bridge/routers and other networking gear, while LNM is better for managing LAN segments and attached stations. Interestingly, IBM opted for SNMP in the first release of its 6611. Doubtless, it will add LNM to a later release.

The Test Bed

The test configuration used for this round closely resembles that employed for the earlier local and remote bridge tests. Two Token Ring LANs were connected by a pair of bridges or bridge/routers. Traffic was generated on both Token Rings using DA-30 analysers from Wandel & Goltermann. LAN analysers were used to count the number of packets that made it through the WAN link to the destination rings. The Token Ring LANs operated at 16Mbps. The physical connections were made with unshielded twisted-pair (UTP) cabling and a Crossbow FX6604E hub from Fibermux. FCD-1 CSU/DSUs from RAD Data Communications simulated the wide area link.

Remember, the Lab is located in the US and as a consequence tests are conducted at US (rather than Australian or European) line speeds. Last year, all the tests were run at four line speeds (56, 256, 768Kbps and T1 (1.544Mbps)), and four different frame sizes were used on each line (64 and 256 bytes and 1 and 2Kbytes). Since the test results did not vary that much as line speeds and frame sizes were changed, only leading indicators were measured this time out. Line speeds of 56Kbps (entry-level networks) and T1 (typical backbones) and 64 byte packets (typical of acknowledgments) and 2Kbyte packets (typical of file transfers) were used. The mainstay of these evaluations are the dual-sided steady-state tests. These require a bridge to forward as much traffic as possible in both directions without dropping a significant number of packets. The point when packets are dropped is noted and the throughput achieved at that point is recorded as the device's maximum possible throughput.

Test Results

Overall, the test results were encouraging. Once again this year, the greatest range of performance was seen with small packets at low and high line speeds. With large frames,

Proteon.

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As networks become linked, it is reassuring to know Proteon is involved in supplying the physical interconnectivity.

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1st in Harvard Benchmark Test

Proteon's RISC-based CNX 500 Bridging Router has rated top performer in the 1991 and 1992 Harvard Benchmark Test. This independent test measures speed and throughput in multi-LAN, diverse environments among 15 of today's vendors of bridges and routers.

It is not surprising that top Australian companies who are bringing their remote and local networks together on a price/performance basis are turning to Proteon.

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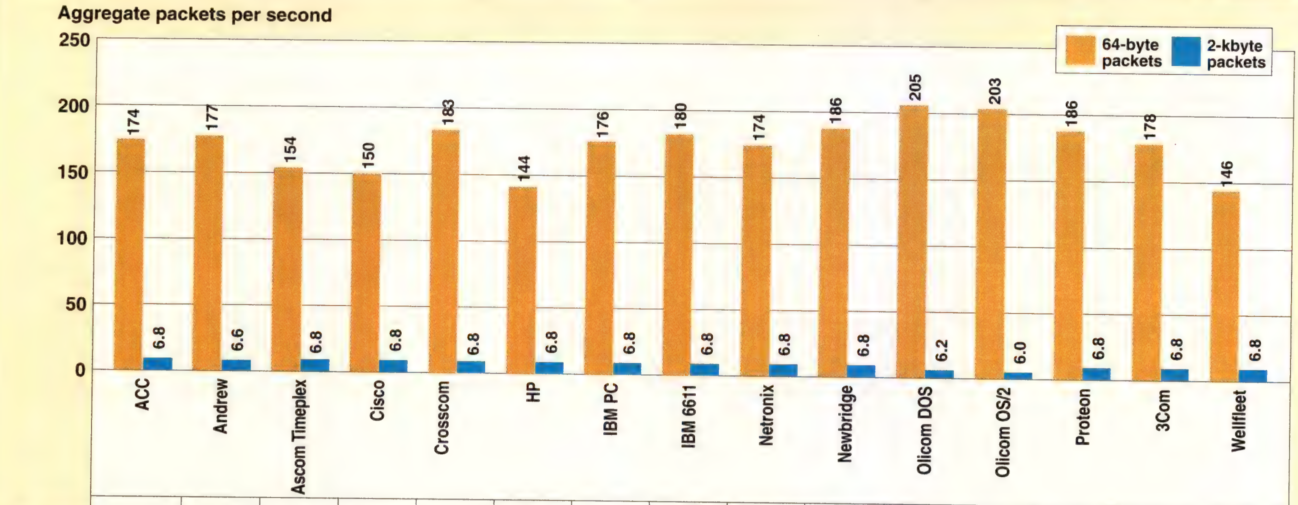
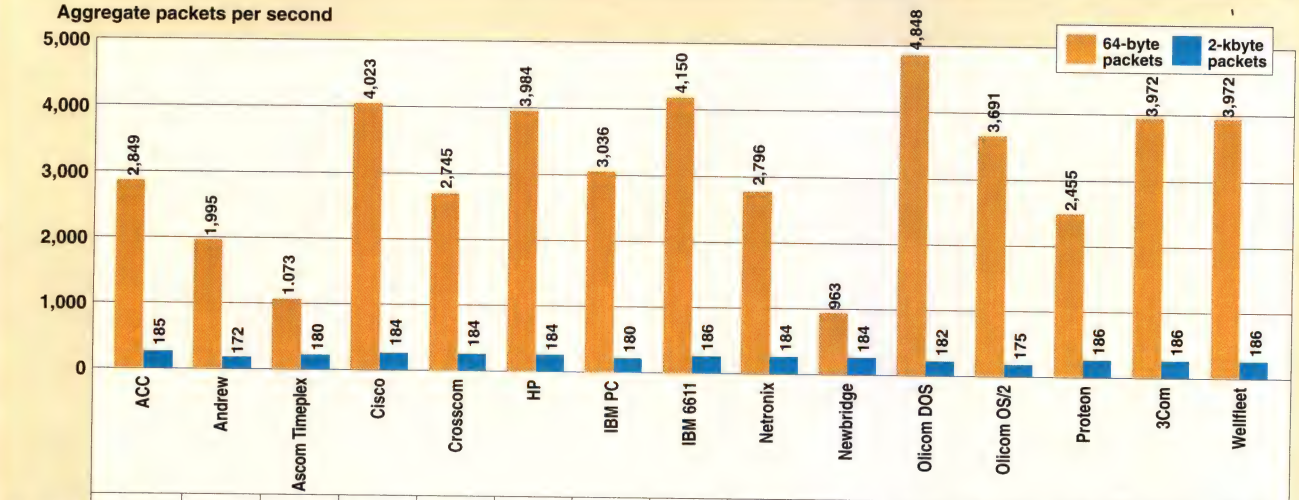
Figure 1: Packet-Handling Test (Two-way traffic, 64-byte and 2-kbyte packets at 56Kbps)



Bandwidth utilised (%)	ACC	Andrew	Ascom Timeplex	Cisco	Crosscom	HP	IBM PC	IBM 6611	Netronix	Newbridge	Olicom DOS	Olicom OS/2	Proteon	3Com	Wellfleet
64 bytes	79.54	80.91	70.40	68.57	83.65	65.82	80.45	82.28	79.54	85.02	93.71	92.80	85.02	81.73	66.74
2 kbytes	99.56	96.63	99.56	99.56	99.56	99.56	99.56	99.56	99.56	99.56	90.77	87.84	99.56	99.56	99.56

Figure 2: Packet-Handling Test (Two-way traffic, 64-byte and 2-kbyte packets at 1.544Mbps)



Bandwidth utilised (%)	ACC	Andrew	Ascom Timeplex	Cisco	Crosscom	HP	IBM PC	IBM 6611	Netronix	Newbridge	Olicom DOS	Olicom OS/2	Proteon	3Com	Wellfleet
64 bytes	47.0	33.25	17.88	67.05	45.75	66.40	50.60	69.16	46.60	16.38	80.80	66.01	40.91	66.20	66.20
2 kbytes	98.66	91.73	96.0	98.13	98.13	98.13	96.0	99.20	98.13	98.13	97.06	93.33	99.20	99.20	99.30

virtually every product can achieve wire speed from 56Kbps to T1 levels.

When it came to the steady-state tests with 64-byte packets at 56Kbps, Olicom took the top slot (see Figure 1). Both its boxes utilised 94% of the available WAN bandwidth. This is essentially a repeat of its winning performance of last year. Wellfleet and Hewlett-Packard finished in the last two slots, with Wellfleet using nearly 67% and HP using almost 66%. HP's router is based on Wellfleet software.

Such low transmission speeds shouldn't burden any of the boxes, so disparity in performance came as something of a surprise. At low line speeds a limiting factor may be that each vendor's encapsulation technique contributes significantly to its product's abilities (bridges and routers encapsulate local area network frames in a wide area network protocol, such as HDLC). It's also likely that the efficiency of a vendor's internal code contributes to these differences, and since CPU power, as noted earlier, is not a factor, and many vendors use the same Token Ring chips and drivers.

When it came to pushing small packets over high speed lines, vendors this year came far closer to meeting their stated performance goals. Although none of the bridges could fully fill the pipe, the majority exceeded 2,700 pps. Last year, almost all vendors ran at between 1,300 and 1,900 pps. In fact, 12 of the vendors this year outperformed last year's second-place finisher.

First-place honors once again went to Olicom, whose DOS-based bridge forwarded 4,848 packets per second. Last year, the bridge achieved 4,614 pps (see Figure 2). Other notable performers included Cisco, whose 4,000 pps is better than double last year's 1,892 pps — thanks to a fix in its serial-line interface. IBM placed near the top with the 6611, as did newcomer 3Com. Both passed over 4,000 pps. Last year, at low

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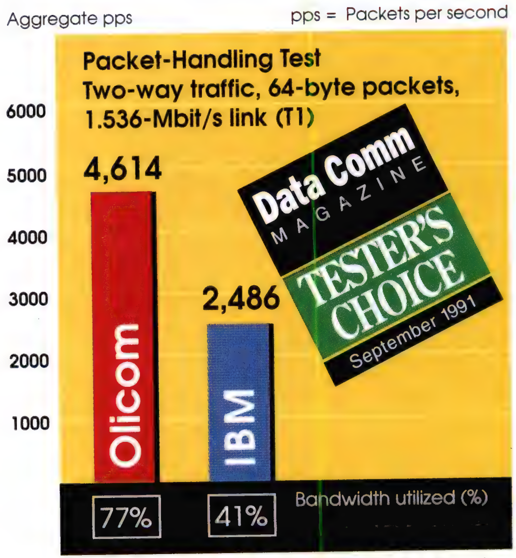

6,000 packets per second = 1.536 Mbit/s full duplex
Compression off

Data Comm's Test Lab says, "Olicom's remote Token-Ring bridge delivers unparalleled packet processing—a major advantage for high-speed WAN links."

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Bergsøe 3

speeds and with large packets all the vendors but Crosscomm utilised 99.9% of available bandwidth. A quirk in Crosscomm's software caused its product to split 2Kbyte frames into separate packets. Now that this flaw has been corrected, Crosscomm turned in the same outstanding performance as the other vendors.

And at high speed levels with large packets, all vendors are running at or near line speed. This level of performance is possible because large packets reduce the overhead involved in reading and processing packet headers. Of all vendors tested, Crosscomm shows the most serious commitment to boosting performance over WANs. This ensures the integrity of SNA sessions. Its ILAN bridge/routers feature NetBIOS name caching and protocol-independent routing, to help make sure that critical data reaches its destination — even when wide area network links bog down.

Once again, Olicom is the speed demon of the remote Token Ring tests. It's Remote Bridge 16/4 and server-based OS/2 bridge program turned in blazing performance numbers with small and large packets at 56-Kbps and T1 lines.

Kevin Tolly is Director of the Data Comm Test Lab and President of Interlab, New Jersey.

IBM's 6611: A Router to Reckon With

In just about every test of internetworking products it's conducted, the Lab has called for better configuration and maintenance capabilities. It seems as if IBM was listening: Its 6611 bridge/router breaks new ground when it comes to both. The Lab believes it to be one of the most significant products to have come along in recent years — it is due for release in Australia in the early half of 1993.

The documentation for the 6611 is a model of clarity. Its first entry, for instance, explains whether changes in configuration will take affect immediately, only after an interface is restarted, or only after the entire router is rebooted. With most other routers, it's impossible to tell when a change will take affect: The only approach is to bring the whole device down and reboot it.

When it comes to ongoing software maintenance, the 6611 borrows from tried-and-true mainframe techniques. The software is modular, which makes it possible to upgrade individual protocols rather than installing an entire new release. Even better, the 6611's software installation and maintenance subsystem allows users to test new modules and then accept or reject them. In the latter case, the 6611 automatically reverts to its earlier state. With most routers, if an installed upgrade is deemed unacceptable, it's necessary to reinstall all the old software. What's more, it's possible to determine the serial number and version of all modules from the net management console, meaning no more pulling boards to see exactly what is or isn't installed. The 6611 also handles popular routing methods such as open shortest path first (OSPF) and the routing information protocol (RIP).

The only shortcoming of the 6611's configuration and management capabilities is the speed at which the management program operates. The configuration program is implemented using the OSF/Motif graphical user interface on top of Microsoft Windows. Every time a network manager uses the graphical interface to look one level deeper, a new Windows task is opened. This is inefficient and doubtless explains the sluggish performance of the management program.

Kevin Tolly

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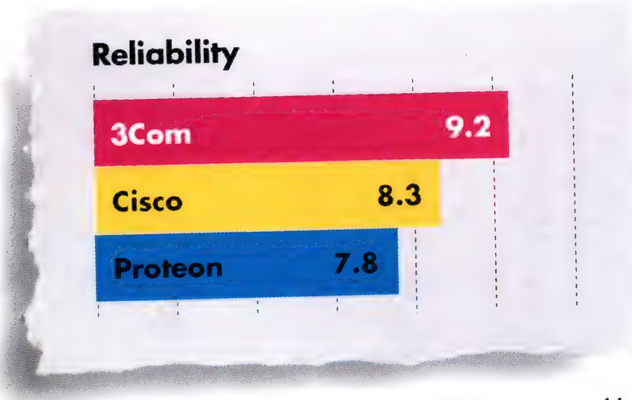
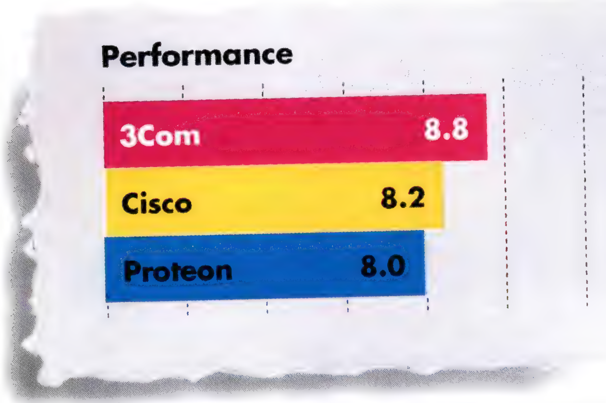
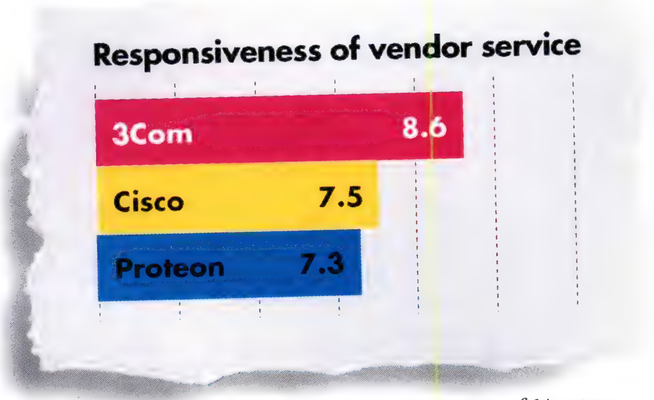


In a recent Buyers' Scorecard Survey by Computerworld *magazine, network managers rated leading bridge/routers. 3Com's NETBuilder® was rated Most Reliable, ahead of the market leader.*



The Computerworld *survey also rated NETBuilder highest for Performance. In another recent study — this one by Harvard University — NETBuilder II was 60.1% faster than the nearest competitor for FDDI routing.*



In fact, NETBuilder got the highest ratings in 11 of 14 categories. That included Value, Physical Design, and Responsiveness and Quality of Vendor Service and Support.

Most network managers know 3Com for adapters only. That's too bad, because both experts and users say our NETBuilder family of bridge/routers is the best in the business.

Computerworld asked 20 NETBuilder users if they would buy the product again, and 20 out of 20 said yes – an unprecedented customer loyalty of 100%. It's no wonder that last year *Systems Integration* magazine rated NETBuilder one of its "Products of the Year."

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EDI - A Better Way is a learning program on the key business topic of *Electronic Data Interchange* (EDI).

EDI is the technical name for 'paperless trading', a system under which organizations could theoretically eliminate all paper orders, paper invoices and paper payments. Instead, all these transactions are conducted electronically - directly between individual companies. It is already well-established in the handling of import/export transactions and customs clearance. It is a step towards improved efficiency, productivity and competitiveness.

EDI - A Better Way is shrink wrapped, and contains two booklets, two training videos and a set of computer disks which can be used for interactive training.

The kit has been produced by the Department of Administrative Services in Canberra, and is manufactured and distributed by Standards Australia. It has a retail price of $119; $109 for members of Standards Australia, EDICA (The EDI Council of Australia) and government departments.

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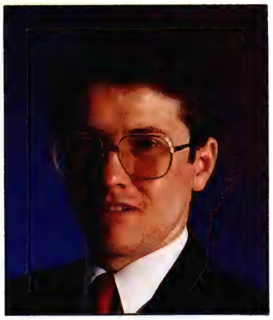


Benchmarking — How Do You Rate?

Brian White

Benchmarking leads to better management! This month I will start an important series of columns on how the Communications Manager can use the process of benchmarking to ensure that all stakeholders in the **communications function** are well served. Those stakeholders (users, communications staff, suppliers and executive management) are all putting more pressure on the Communications Manager than ever before. Benchmarking can be used to determine how well the Communications Group is performing and how it can improve. In this way it is a defensive measure against the threat of wholesale outsourcing, but benchmarking is much more than a defensive measure, as we will see.

Starting with the proposition that there is always room for improvement (especially in times of rapid regulatory, economic and technological change), the Communications Manager needs a method or process which improves quality in all dimensions of the communications function. Benchmarking of the Communications Group is based on the belief that performance against user expectations is the only viable way to evaluate the Group and establish action plans to improve Group performance. Therefore communications users serve as the primary force behind the change process started by benchmarking. The link between user expectations and Communications Group performance has been discussed in previous articles on chargeback.

What is Benchmarking?

In a nutshell, the benchmarking process attempts to identify current performance of the Communications Group (both quantitatively and qualitatively) with reference to industry 'best practice' to determine 'performance gaps.' Performance is improved by eliminating wasteful tasks and by introducing these best practices. In fact bench-marking only finds fault with processes rather than people.

It does not stop there, in fact it never stops. Benchmarking leads to the continuous measurement of key indicators or metrics, which then drive the improvement process (if the commitment and effort are maintained). Continuous improvement is necessary in all areas, not just communications, because if you stand still, you will actually go backwards in relation to your peers and competitors within your industry. This point is even more important in the communications field due to the rapid technological and regulatory change.

Benchmarking examines all the critical success factors (CSFs) related to strategic issues, the roles of staff, the processes they support, what they do (effectiveness) and how well they do it (efficiency). Although the benchmarking procedure examines current performance at many levels, it is not simply a method of scoring, the objective is to **improve the score** by implementing change and better practices. Each iteration of benchmarking generates actions for improvement.

Key Definitions

Quality	Giving the customer or the next person in the process a product or service that meets their requirements and doing this in a way to ensure each task is done right the first time, every time.
Benchmarking	External focus on internal activities, functions or operations in order to achieve continuous improvement in service effectiveness and efficiency.

Benchmarking is not one-dimensional like cost cutting exercises. To be effective, benchmarking must examine all areas of the communications function (finance, support, technology) to determine what can improve and how the whole communications function can improve. The table on page 104 lists some of the key questions and areas of focus. If there is only a focus on financial issues there is a danger of unnecessary cost cutting. If the focus is technology, there is a tendency to use technology without a direct tangible benefit. If the focus is only the support issues, there may not be enough consideration of the relationships between the necessary support skills and the rapidly changing technology.

History

Although benchmarking can be traced back to the competitive assessment techniques of the 1950s, the more recent resurgence of benchmarking in general management came in the 1970s, when Xerox Corporation in the US found that Japanese competitors could sell products at a price lower than Xerox's cost of manufacture. Xerox's response was to compare its own internal processes and performance with those of their Japanese competition. Until this point, Xerox believed that its steady annual improvement in productivity was enough. The only answer was to implement fundamental change and to use industry best practices. In the late 1980s, Total Quality Management (TQM) became an attractive management philosophy (see the February 1991 *Management* column). Also, in the last few years the information technology industry has seen a growth in the process of quantitative benchmarking. Quantitative IT

Why Benchmark?

1). Involves all staff in ongoing problem solving
2). More lateral activity between staff within the organisation
3). Leads to a more responsive & customer driven service delivery
4). Fosters a culture of ongoing change and learning
5). Signals management's willingness for pro-active change (rather than reactive change)
6). Establishes more meaningful individual and group goals and performance measures
7). Generates process-oriented thinking
8). Searches for high pay-off opportunities
9). Creates early awareness of competitive disadvantage
10). Promotes teamwork driven by data and competitive need

benchmarking tries to put a value on parameters such as cost per MIPS, support staff cost per MIPS, mainframe availability level percentage, ratio of average load to peak processing load, etc.

Is benchmarking different from the continuous improvement and TQM schemes and policies now becoming popular? The answer is sometimes yes, if continuous improvement is implemented with an internal focus, because without an external reference (i.e. industry best practice) it can be vague and more difficult for staff to understand and implement. Internally focussed continuous improvement also makes it more difficult to overcome organisational barriers to change and more difficult to overtake the performance of competitors. The external reference demonstrates what is possible and what is actually happening. Ultimately, a quality improvement philosophy will only work if there is a clearly understood mechanism for implementing improvement and change.

Summary

Benchmarking is a self-improvement and management process that must be continuous to be effective. In an environment of constant change, complacency is fatal, so looking outside to the best practices is an important way to stay competitive. Benchmarking provides management with tools to make hard decisions about resource allocation and strategic focus.

In future columns I will go into more detail on how benchmarking data are collected, how the data are analysed and how to formulate action plans for continuous improvement.

Brian White is a Senior Consultant at AAS Pty Ltd (Sydney) where he specialises in strategic planning, network engineering, benchmarking and communications management.

The Scope of Benchmarking

BENCHMARK ASSESSMENT CATEGORY	PRIMARY QUESTIONS	EXAMPLE AREAS OF FOCUS
Financial Assessment	Is expenditure well directed and are costs and funding under control?	Carrier costs Maintenance costs Support costs On-costs Traffic measurements Usage measurements Asset register Equipment age and remaining life Depreciation value & replacement value Return on investment Infrastructure costs Communications applications costs Chargeback & cost control procedures
Support Assessment	Are the right services delivered to users and are users supported satisfactorily?	Levels of user satisfaction Staff structures & responsibilities Staff career growth, morale Staff training and new skills Support procedures Fault resolution & escalation Management and administration tools Service Level Objectives Relationships with vendors, carriers, etc. Maintenance & service contracts Documentation & change controls Delivery of new/changed services
Technology Assessment	Are appropriate technologies being used and are they implemented properly?	Communications applications Technologies in use Carrier services in use Protocol architecture Logical network (application) designs Physical backbone network design Standards Hardware/software interfaces Network availability Security Performance and response times Functions and features

In the February edition of

AUSTRALIAN
communications

INTERNATIONAL LINKS
Australia must export to survive, but how can Australian companies successfully compete in the overseas marketplace without suitable overseas communications links? Next month we explore the international communications options now available.

NETWARE 4.0
Novell is in the midst of a big drive to make its NetWare LAN operating system a killer platform for enterprise networking. Next month we take an extended, in-depth look at the new NetWare 4.0 and the critical parts of Novell's enterprise networking strategy.

THE IDAs: A FAILURE?
Designed to foster local industry, the Industry Development Arrangements have been the subject of considerable controversy ever since they were launched. Now as the scheme enters its final phases, the time has come to take a long hard look at just how successful they've been.

AUSCOMMS BUYS A WAN II PART #2
In the second part of our special 'AusComms Buys a Data Network' feature, Brian White takes a close feature-by-feature look at the specific functions provided by each of the nine solutions put forward as well as discussing the more interesting networking issues involved.

Advertising Enquiries:
Craig Burkill
(02) 264 2200

RAD's SDLC Converter For LAN Hubs

Product:	STC-1, RR-STC-2
Vendor:	Dataplex 232 Whitehorse Road Blackburn VIC 3130 Tel: (03) 735 3333 or (03) 210 3333 Fax: (03) 210 3399
Price:	STC-1 — $4,946. RR-STC-2 price is not yet available.
Features:	Hub-based SDLC converter enables central management of SNA/Token Ring internets.

Now that SDLC conversion has emerged as the technology of choice for integrating SNA and Token Ring networks, the logical next step is to incorporate it into LAN gear. RAD Data Communications aims to be the first out of the gate with an SDLC converter that fits into an intelligent LAN hub. After launching its standalone converter in October, RAD plans to ship a card version for its RADring Intelligent Modular Token Ring Hub by year's end. RAD's hub-based synchronous data link control (SDLC) converter can be managed using the same network management facilities as the other Token Ring components in the hub, effectively centralising management of the SNA/Token Ring internetwork.

To date, SDLC conversion — the process of terminating SDLC traffic from mainframes and converting it to logical link control (LLC) format for Token Ring LANs — has been available only in standalone products or bundled with routers, which often are managed separately from other Token Ring components. RAD's standalone SDLC converter, the STC-1, and its hub-based device, the RR-STC-2, are both installed on the Token Ring (see figure). The STC-1 connects up to 16 multidropped IBM 3174 or 3274 cluster controllers over a single wide area connection. The RR-STC-2 also connects up to 16 cluster controllers and supports two wide area links for extra redundancy. The products connect to wide area gear such as modems and multiplexers via V.24 or V.35 interfaces.

By converting SDLC packets into LLC ones and vice versa, the STC-1 and RR-STC-2 enable remote cluster controllers to communicate with host computers via the Token Ring. SDLC conversion is one of two methods being implemented by vendors for merging SNA and Token Ring networks. The other, called passthrough, encapsulates SDLC data inside TCP/IP packets. SDLC conversion saves users money by eliminating the need for each cluster controller to be connected to its own dedicated front-end processor (FEP) port. Instead, multiple cluster controllers can be connected via a single FEP equipped with an SNA gateway.

The RAD devices also save users money by minimising the number of polling messages exchanged over the network between FEPs and cluster controllers. The converter itself replies to polling messages from the cluster controllers, thereby appearing to them as a FEP. In addition, the RAD hub appears to the actual FEP to be a simple Token Ring adaptor. As a result, the FEP polls it far less frequently than if cluster controllers were directly attached to it.

The new STC-1 and RR-STC-2 products will fit into users' networks without extra reconfiguration, according to RAD, because they support all communications modes used by cluster controllers and FEPs, including clocking, full- and half-duplex transmission, and nonreturn to zero (NRZ) and nonreturn to zero inverted (NRZI) encoding.

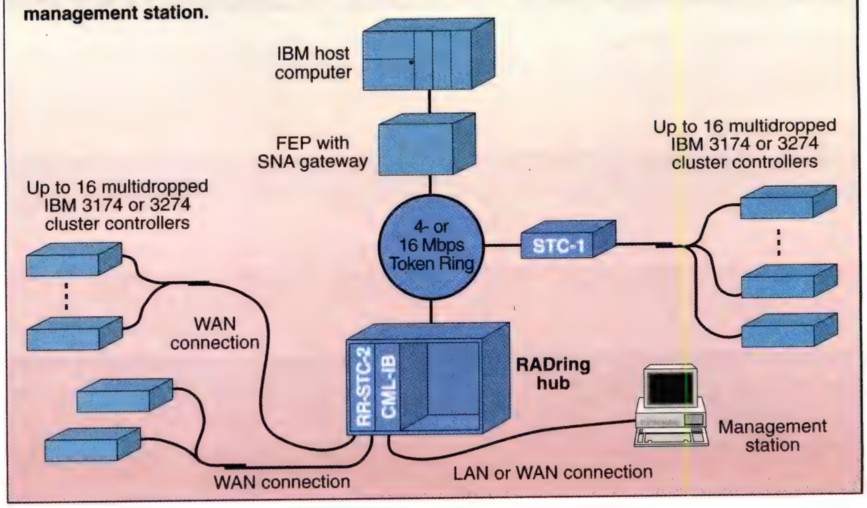
RAD says the STC-1 and RR-STC-2 have several advantages over IBM's products for integrating SNA and Token Ring networks. Big Blue offers two solutions. The first is an upgrade for its 3174 cluster controller that allows it to imitate a Token Ring attachment. The upgrade comprises microcode, a Token Ring adaptor card, and in some cases extra memory. RAD's products also can be used to integrate IBM's 3274 controllers, which do not support an IBM upgrade. IBM's second option is its 6611 router, which performs SDLC conversion. The router's conversion process, which IBM calls Data Link Switching (DLS), merges SNA and Token Ring networks by terminating SDLC traffic and responding to polling messages from the router most closely connected to the FEP. The router switches the SDLC header with a Token Ring LLC header and sends the packet along as LAN traffic. The 6611 is due to be available early next year, although it will cost considerably more than RAD's hub product.

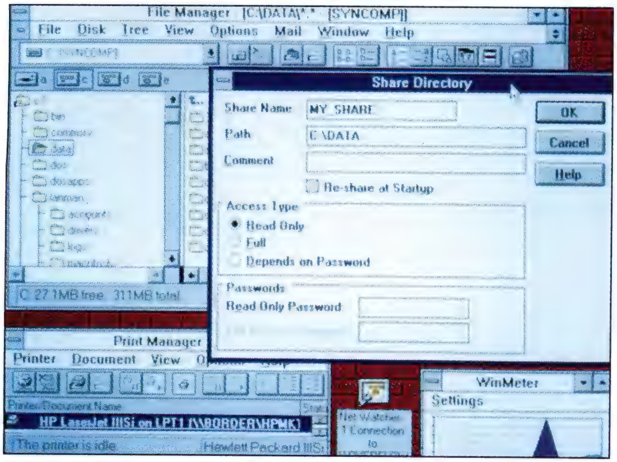
RAD's products also compete against standalone SDLC converters such as the Link Server from Netlink and the SNAC/TRC from Sync Research. Both devices support more wide area ports than the STC-1 and RR-STC-2, and can be connected to more cluster controllers. With multidrop connections, the Link Server can support 32 cluster controllers and the SNAC/TRC supports up to 60. But RAD users in need of greater capacity can load up to 10 RR-STC-2s into a single RADring, allowing 160 cluster controllers to be supported from a single point.

Stephen Saunders

Building a Token Ring/SNA Internetwork

RAD Data Communications' standalone STC-1 and hub-resident RR-STC-2 each connect up to 16 multidropped IBM 3174 or 3274 cluster controllers to a Token Ring. The vendor's hub-based CML-IB allows users to manage all components via an SNMP network management station.





Share Name: MY_SHARE

Path: C:\DATA

Comment:

☐ Re-share at Startup

Access Type

● Read Only

○ Full

○ Depends on Password

Read Only Password:

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HP LaserJet IIISi on LPT1 (\\BORDER\HPMK)

The printer is idle

Windows for Workgroups includes new network server features

Microsoft Brings Windows to Workgroups

Software giant Microsoft has released a new version of its wildly successful Windows operating environment designed specifically for workgroups. According to company officials the new Windows for Workgroups 3.1 combines the Windows operating system with additional networking and workgroup functionality directly integrated. It enables users to install network cards and configure network software with intelligent defaults. In addition, it helps to maximise RAM availability in network attached PCs.

The product includes Microsoft's electronic mail application, Microsoft Mail, and Schedule+, the company's graphical scheduling application. Dynamic Data Exchange (DDE) is also supported and Windows for Workgroups also caters for security requirements by allowing users to set access guidelines to their shared directories, printers and DDE items. Because it's part of the Windows Open Systems Architecture (WOSA), the product also fully supports the MAPI interface in conjunction with Microsoft Mail.

Pricing for the Windows for Workgroups product starts at $390. A Windows for Workgroups Starter Kit, which includes software and hardware to connect two PCs, is priced at $1,400. A User Kit, which includes all hardware and software required to connect an additional PC to a Windows for Workgroups network, is also available and priced at $700. Current Windows 3.1 users can upgrade to Windows for Workgroups for $185.

Microsoft (02) 870 2200

UnixWare Launched

Univel, the Novell-Unix Systems Laboratories partnership, has announced the introduction of UnixWare, a client-server Unix operating system designed for seamless integration with Novell's NetWare network operating system.

The UnixWare family runs on Intel 386, 486 and future processor releases. It also boasts a graphical user interface, advanced Unix system capabilities and NetWare integration facilities which officials say will allow users to develop and deploy applications in distributed computing environment.

The family consists of three core products — a client known as the Personal Edition which is a single user Unix system designed for integration with NetWare; an Application Server which provides multi-user access to Unix applications and includes TCP/IP and IPX/SPX networking; and a Software Development Kit which provides a complete set of development tools for programming in the UnixWare environment.

With a modular product architecture, the UnixWare family enables system growth from a standalone platform or networked client to a fully functional server system, claim company officials.

Based on Unix System V Release 4.2, UnixWare's user interface is based on the distributed X Windows graphical subsystem, and incorporates a whole set of graphical tools implemented with a drag-and-drop style of operation.

According to officials, Unixware provides shrink-wrapped compatibility with SCO Xenix, SCO Unix, Interactive Unix and applications written to the Intel iABI standards.

Univel (02) 938 2191

Desktop Videoconferencing

A new range of desktop videoconferencing products has been released by MegaVision which company officials say can transform AT-based PC's into desktop videoconferencing workstations. The new DTVC system includes a hardware and software utility which, when used with AT&T's Systimax Premises Distribution system, enables any video source to be distributed through existing UTP wiring directly to a PC under Microsoft Windows 3.1 supporting multimedia functionality.

The addition of a video camera to the PC facilitates a two way broadcast within a building, and the addition of a single audio/video codec allows videoconferencing between distant sites at the ISDN Basic Rate of 128Kbps.

Residing in an AT compatible PC-386 or above, the new system's DTVC codec is H.261 compatible and operates at N x 64Kbps. It operates in both PAL and NTSC modes and can translate between the two systems. Offering a high standard picture detail and colour resolution, DTVC may also operate in a Windows 3.x environment for user friendly operation.

MegaVision (02) 975 1877

Low-End Router

Ungermann-Bass has recently announced the Australian release of Wellfleet's new Access Feeder Node low-end multiprotocol router/bridge. Including 4M of RAM, the single-board node is based on Motorola's 25MHz MC68030 microprocessor and provides one Ethernet and two synchronous interfaces for integrating SNA/SDLC traffic.

According to company officials, the product supports a range of LAN and WAN products, and when used in a Wellfleet-based network offers an integrated management solution whereby the node is controlled and managed from a single site.

The node's two synchronous connections allow configuration of redundant connections to one site to provide higher bandwidth and assure continuous operation; establishment of alternate routing paths to the backbone via two different sites; and local connections of SNA/SDLC devices with one link to the backbone.

Products supported by the Access Feeder Node include TCP/IP, Novell IPX, DECnet Phase IV, AppleTalk Phase 2, XNS, Spanning Tree Transparent Bridge, Transparent Sync Pass-Thru, X.25, frame relay and Source Router Bridge as well as Point-to-Point Protocol. The new router product is priced at around $10,000.

Ungermann-Bass (03) 696 2006

LAN PC

Apricot Computers has introduced its new LS Pro — a PC which company officials say is specifically designed for workgroup computing.

Based on the Intel 386SX or Cyris 486SLC 33MHz processors, the LS Pro boasts a built-in Ethernet or Token Ring interface, standard VGA monitor and Apricot's LOC security system.

Apricot's LS Pro boasts a built-in network interface

The built-in network interface is based on an Intel 82596 network co-processor and supports thick or thin coax and UTP wiring. Priced from $1,595, it can accommodate up to 16M of RAM and a 515M hard disk.

Apricot has also announced LOC Manager, a new software product designed to enhance the company's already sophisticated security system. Company officials say that the new product enables network administrators to control data security across an entire network from a central workstation.

Apricot (02) 888 9444

DEC-IBM Links

Proteon has developed a new implementation of its DECnet Phase IV forwarder which company officials say enables the comprehensive integration of Digital and IBM environments.

Incorporated into the company's router software, the new implementation enables DECnet Phase IV to operate over the Source Routing bridges found in IBM Token Ring internetworks. According to company officials, the DECnet-based applications such as PATHWORKS are now better able to traverse existing 802.5 Token Ring networks.

As part of the release, the company also offers users the ability to set a Locally Administered Address for IBM internetworking procedures through its CNX500 and p4100+ routers. According to company officials, the products allow each end node to retain an independent address in order to access an IBM host or utilise protocols such as NetBIOS.

Proteon (02) 412 0050

AS/400 Connectivity

Network Systems Technology has entered the IBM AS/400 midrange computer connectivity market with the release of the Elite/400 family of PC-to-AS/400 communications products. Comprising four new software products for Windows and a PC-to-AS/400 file transfer facility, the new Elite/400 product family embodies fourth generation, APPC-based 5250 emulation technology.

The first product in the range is the Elite/400 for Windows which enables PCs to access AS/400 applications and databases by emulating IBM's 5250 family of terminals and printers. The Elite/400DSP is a lower priced version of the emulation product deigned for users who do not need the entire complement of IBM's Personal Computer Support (PCS/400) software product features.

Both emulator products feature automatic session configuration, automatic font and window sizing and a productivity-enhancing ShortCuts facility for user-defined, mouse activated host functions. Both versions can now also communicate over 802.2, SDLC and twinax links, and LAN gateways including NSA's Elite/400 LAN Gateway and NetWare for SAA Gateway.

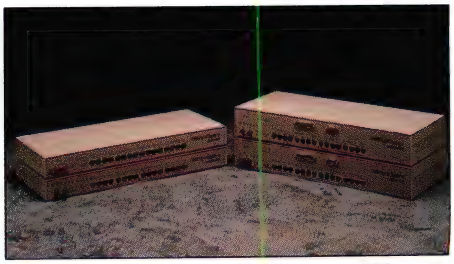
The second product in the line is the Elite/400 LAN Gateway which can be used on Token Ring, Ethernet, Arcnet, and also peer-based LANs. It will allow multiple PCs to share a single link to the AS/400 for client-server applications.

The HLLAPI Toolkit for Windows is the third product in the new line and encompasses an optional software development package for the rapid creation of Windows interfaces for existing AS/400 applications by using IBM's HLLAPI and Microsoft's Visual Basic. The APPC Toolkit for Windows is a similar development package for use with the APPC API for Microsoft Windows.

Prices for the new Elite/400 product family range from $150 for the Elite/400DSP to $23,600 for the Elite/400 NLV (NetWare for SAA) for a 254-station network licence.

Network Systems Technology (02) 957 3880

LattisLink hubs feature 16 10Base-T ports


The LattisHub range can support up to 80 ports

SynOptics Revamps Low-End Hub Product Line

SynOptics Communications has recently released two new Ethernet hub product lines designed for small to medium-sized workgroups. The company has also released a new version of its Lattis EZ-View network management software to help integrate the new hubs into Novell NetWare environments.

Officials said the new LattisHub Ethernet hub range enables users to build an entry level system that can be incrementally expanded to support up to 80 fully managed 10Base-T ports. Made up of four models — the 2803, 2804, 2813 and 2814 — each member of the LattisHub range feature 16 10Base-T ports and expansion port connections. The 2803 and 2813 models include a standard AUI interconnect port and the 2804 and 2814 models include a 10Base-FL port for dual attachment to fibre backbones.

Priced from $4,125 and $4,665 (excluding tax) respectively, the LattisHub 2813 and 2814 are management units and feature one interconnect port and four expansion ports for connecting LattisHub 2803 or 2804 host units. Network management software agents are available with both the 2813 and 2814 models and company officials claim that full SNMP management is automatically extended to a cluster of 2803 and 2804 models attached to a management unit. The 2813 and 2814 models also include flash EEPROM, eliminating the need for a separate boot server. Priced from $2,324 and $2,864 (excluding tax) respectively, each LattisHub 2803 and 2804 host unit includes one expansion port and is supplied with a Model 988 Expansion Cable, which acts as a virtual backplane for connecting 2813 and 2814 management units.

Lattis EZ-View version 2.0 provides support for SNMP management over IPX (Internet Packet Exchange). This feature allows network managers to easily install and manage LattisHub systems in Novell NetWare environments.

Also released, the new LattisLink workgroup hub is an unmanaged 16 port 10Base-T hub designed for small workgroups. Priced at $1,785 (excluding tax), the hub features 16 RJ-45 10Base-T ports and one AUI interconnect port. It also features an internal power supply and an MDI-X/MDI switch which allows hubs to be connected by standard 10Base-T cabling.

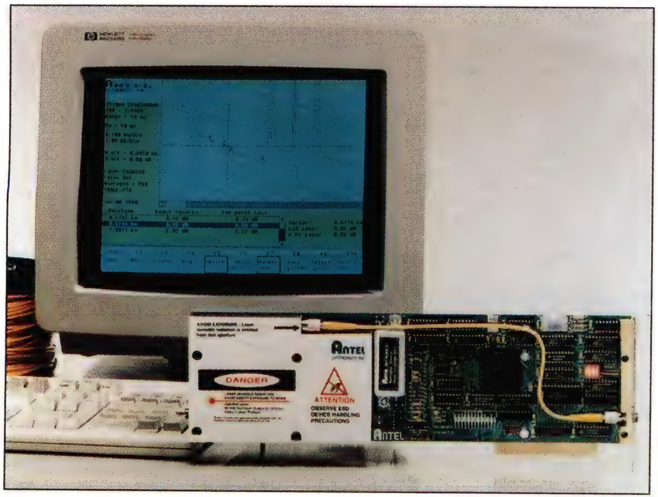
SynOptics Communications (03) 853 0799

Network Management

Scitec Communication Systems has announced the release of its Australian-designed and manufactured InSight network management system.

Designed for heterogeneous networks, InSight provides for centralised or distributed control and is based on an expert

InSight is designed for heterogeneous network management



The Antel Optical TDR is designed for optical fibre testing

system able to capture and interpret network status information. The product features support for SNMP and Scitec claim it can handle a range of equipment manufactured by other vendors.

InSight is a key component of Scitec's new Intelligent Network Resource I^{2}R strategy, according to company officials.

Scitec (02) 428 9555

Optical Testing

A new Antel Optical TDR on a PC card has been released by Kingfisher for singlemode optical fibre measurements.

Fitting into a standard PC slot, the instrument performs acceptance testing of cable drums, characterising installed cable, checking splices and connectors, and fault finding.

The product is available in 1300 nm, 1550 nm and dual configurations, and features a range of 26 dB and deadzone of 18 metres with a reflective event of 3 metres with a fusion splice. The card requires a 386 or 486 based PC with maths processor, and is packaged with software.

Kingfisher International
(008) 807 369

Modems

Hayes Microcomputer Products has introduced two new modems in its Optima range — the V.32*bis* Optima 144 and V.32 Optima 96. Both support V.42 error-control and V.42*bis* data compression, which allows data to be transmitted at speeds of up to 38,400bps, company officials said. Each also support Hayes AutoSync, a Smartmodem feature that allows synchronous communication without using an SDLC or Bisync card.

The new Optima 144 is V.32bis and V.42bis compatible

The Optima product range also features Hayes Escape Sequence with Guard Time along with the Hayes Standard AT Command Set, and Automatic Feature Negotiation which allows analysis of the connecting modem and establishment of the most efficient communication session transparently to the user. The Optima 144 is priced at $1,199, while the Optima 96 is priced at $1,069 (both prices are excluding tax).

Hayes (03) 724 4444

Cable Management

An new version of the ISICAD Command 2000 Cable Management PC software has been rel-

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- Stream to disk up to 1Mbps
- On board interfaces: RS232, V.35, RS422/423, V.10/V.11, RS449
- T1 Pod (E1 coming soon)

Protocols

- HDLC/X.25/X.75
- SDLC/SNA & QLLC
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eased in Australia by MM Systems Engineering for networks with up to 500 users.

The new system integrates an industry standard database with a CAD graphics package to provide a tool for the design and management of the physical network infrastructure. According to company officials, Command 2000 basically acts as a repository for drawings and records, detailing the location, spare capacity and connectivity for a number of network types.

When used as a design tool, the product can generate all required installation documentation including floor plan drawings, rack layouts, terminations records and fully costed bills of quantity.

In addition, as a management tool, Command 2000 is said to reduce network troubleshooting time by providing displays, printed reports and block schematic circuits. The new software is priced at $9,995.

MM Systems Engineering (02) 980 6502

X.400 for cc:Mail

Lotus has expanded its cc:Mail family of products to include a native X.400 implementation.

According to company officials, the new cc:Mail Router X.400 will enable users to migrate to the international X.400 standard, while maintaining the features of the standard message router such as Automatic Directory Exchange, Task Manager, and Dynamic Linking.

Lotus (008) 252 408

Token Ring NICs

SMC has based its new Token Ring product line around its own chipset

Standard Microsystems Corporation (SMC) has entered the Token Ring adaptor marketplace with the release of its new EliteSeries line of 4/16Mbps NICs and MAUs.

The product range includes a 16-bit ISA adaptor, a 16-bit MCA adaptor, passive MAUs, a TSR utility, a LAN Support Program, intelligent MAUs, the Elite Token Ring Hub Card, and the Elite View Windows-based network management application. Also included is PC Agent/SNMP which company officials claim is the first adaptor-level SNMP agent. It provides information about the host PC as well as the card, and will make the SMC Token Card Elite products manageable in any SNMP environment. SMC has also licensed IBM's LAN Support program providing NetBIOS and 802.2 LLC for Token Ring networks, for its own LAN Support Program to ensure complete interoperability with existing IBM environments.

At the heart of SMC's new product line is a new dual-RISC processor chipset that SMC say outperforms current products by up to 50%. In lab tests, company officials claim that the chipset exhibited throughput of up to 25,000 fps.

SMC (02) 238 2206

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4.0	0.4	0.1	0.1
8.0	0.4	0.1	0.1
10.0	0.4	0.1	0.1
16.0	0.4	0.2	0.2
20.0	--	0.2	0.2
25	--	--	0.2
31.25	--	--	0.2
62.5	--	--	0.3
100	--	--	0.4

UTP Connecting Hardware NEXT Loss

Freq. (MHz)	Cat 3 (dB)	Cat 4 (dB)	Cat 5 (dB)
1.0	58	>65	>65
4.0	46	58	>65
8.0	40	52	62
10.0	38	50	60
16.0	34	46	56
20.0	--	44	54
25	--	--	52
31.25	--	--	50
62.5	--	--	44
100	--	--	40

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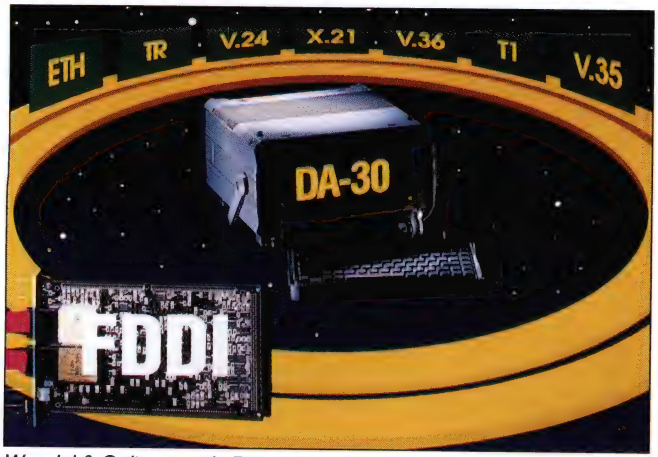

Wandel & Goltermann's DA-30 now has an FDDI interface

DA-30 Upgrades

Wandel & Goltermann recently announced the arrival of the FDDI interface for its DA-30 family of protocol analysers.

According to company officials, the interface transmits and receives traffic in real time at full wire rates and collects information about network events like errors, frame counts, utilisation by protocol and frame size and ring mapping. Also included in the interface are decodes for MAC, SMT and LLC layers, along with upper layer protocols over FDDI including IP, IPX, DECnet, AppleTalk, Banyan Vines and others.

With built-in Media Interface Connectors, the interface also supports both Single Attachment Station and Dual Attachment Station connections.

W&G has also recently expanded the decoding capabilities of the DA-30 by including decoding of AppleTalk, Banyan Vines, OSPF, PPP, QLLC and NetBIOS over IP. It has also bundled all protocol decodes into a single package.

Wandel & Goltermann
(03) 690 6700

Maxima Upgrades

Scitec has enhanced its Maxima product line with a range of locally designed and manufactured modular cards.

The enhancements include a Main Processor Card which provides faster processing capabilities and more memory for each Maxima hub; a G.704 Port Card which allows the Maxima to treat each timeslot in the G.704 stream as a separate channel; a Voice Port Remote Card and a General Server Card.

The VPr 2-wire analogue voice card is now available and offers features such as support for ADPCM and VLBR voice compression down to 2.4Kbps; on-board dynamic echo cancellation; on-board ring and feed generator; and selectable 2 or 4-wire operation.

Plugging into a Maxima 05's chassis and supporting Maxima's new LBRV modules, the VPr allows seven business-quality voice channels to be connected from a central PABX to a

Scitec has released several upgrade cards for the Maxima

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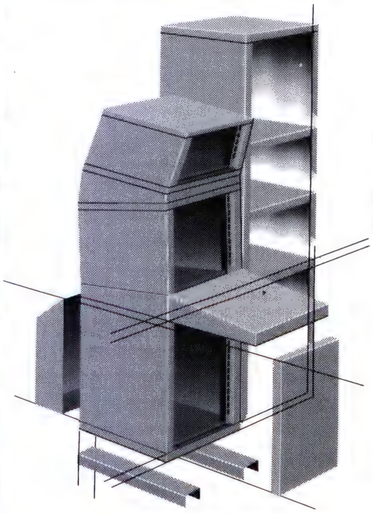

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remote Maxima 05 over a single ISDN B-channel. It is priced from $1,500 per port.

The new General Server card plugs into the Maxima hub node and provides up to 8 channels of compression via user-installable LBRV modules, to allow voice compression at rates from up to 16Kbps down to as low as 2.4-Kbps using ADPCM techniques. It is priced from $1,500 per port.

Scitec Communication Systems (02) 428 9555

Bridge/Router

ADE Network Technology has released the Datability DXA-550 multiprotocol bridge/router for TCP/IP, Novell, SPX/IPX, XNS and Ethernet bridging.

Boasting a filtering and forwarding rate of 15,000 pps, the RISC-based bridge/router has two Ethernet and one WAN port, which officials say makes it ideal for expanding small to medium sized networks.

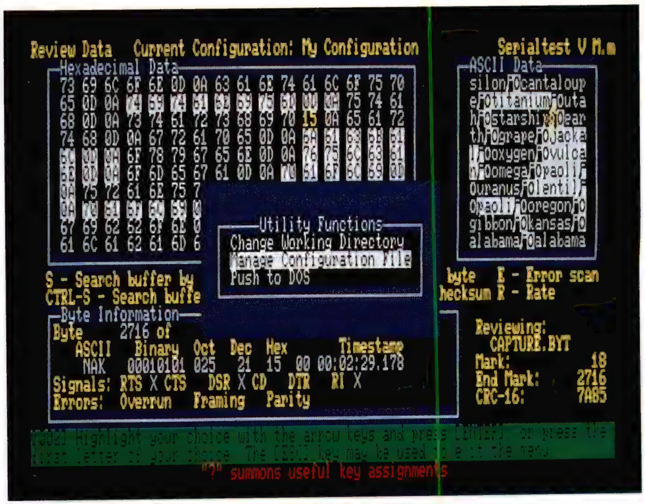
A remote bridging capability enables LANs to be extended across a point-to-point wide area link or through an X.25 or frame relay WAN. The routing protocols operate internally to the DXA-550 and are constantly updated through information arriving from other routers.

ADE Network Technology (03) 543 2677

Serial Data Analyser

Frontline's new Serialtest software has been designed to turn a PC into a serial data analyser to monitor serial communications between computers, programmable controllers, intelligent peripherals and other specialised equipment.

Available in Australia from Reptechnic, the new product allows a PC to monitor existing RS-232C data links or simulate one end of a link in either synchronous or asynchronous environments. The product also includes a range of testing options including Customise Serialtest, Define Triggers, Display Signals, Initialise Datascope, Review Data, Set I/O parameters and Breakout Box.



```
Review Data   Current Configuration: My Configuration        Serialtest V M.m
 Hexadecimal Data                                             ASCII Data
  73 69 6C 6F 6E 0D 0A 63 61 6E 74 61 6C 6F 75 70             silon..cantaloup
  65 0D 0A 74 69 74 61 6E 69 75 6D 00 0A 75 74 61             e..titanium..uta
  68 0D 0A 73 74 61 72 73 68 69 70 15 0A 65 61 72             h..starship..ear
  74 68 0D 0A 67 72 61 70 65 0D 0A 6A 61 63 6B 61             th..grape..jacka
  6C 00 0A 6F 78 79 67 65 6E 0D 0A 76 75 6C 63 61             l..oxygen..vulca
  6E 0D 0A 6F 6D 65 67 61 0D 0A 70 61 6F 6C 69 0D             n..omega..paoli.
  0A 75 72 61 6E 75 7                                         .uranus..lentil.
  0A 70 61 6F 6C 69 0           Utility Functions             .paoli..oregon..
  67 69 62 62 6F 6E 0       Change Working Directory          gibbon..kansas..
  61 6C 61 62 61 6D 6       Manage Configuration File         alabama..alabama
                            Push to DOS
S - Search buffer by                                         byte   E - Error scan
CTRL-S - Search buffe                                        hecksum R - Rate
 Byte Information
 Byte      2716 of                                            Reviewing:
   ASCII    Binary   Oct   Dec   Hex         Timestamp         CAPTURE.BYT
    NAK    00010101  025    21    15   00 00:02:29.178        Mark:          18
 Signals: RTS X CTS   DSR X CD   DTR   RI X                   End Mark:    2716
 Errors:  Overrun   Framing   Parity                          CRC-16:      7A85
(002) Highlight your choice with the arrow keys and press [ENTER], or press the
first letter of your choice. The [ESC] key may be used to exit the menu
                      "?" summons useful key assignments
```

Serialtest turns a PC into a serial data analyser

The product's datascope utility facilitates diagnosis of communications problems by providing a window for viewing data and associated control signals as they pass by. The triggers allow users to capture data, ignore transmissions or halt the monitoring procedure.

Along with Sync and Async, the product supports SDLC, X.25, SNA and HDLC. The Serialtest package is priced at $2,480 for the synchronous version and $480 for the asynchronous version.

Reptechnic (02) 953 9844

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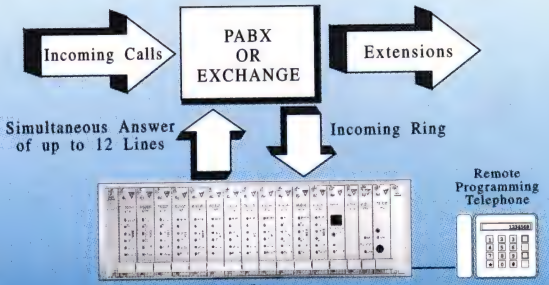
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Marconi's 2965 radio test set features 36 instrument functions

Radio Test Set

A new radio test set from Marconi instruments combines 36 instrument functions with fast multiple measurement capability to test a range of radio systems and associated products.

The new 2965 Test Set is said to provide a range of RF instrument functions including a full span, high dynamic range spectrum analyser with tracking generator, RF power metre, storage oscilloscope, and fast switching RF signal generator. The product also includes a number of audio capabilities including a fast audio analyser and three independent audio generators.

Measurement functions provided by the 2965 range from a sampling 500 kHz digital storage oscilloscope to a built-in, multi-metre for measuring resistance, AC/DC voltage, and current. According to company officials, the unit performs a typical test of transmitter frequency, power and deviation followed by received audio level and SINAD in less than 3 seconds, and updates 10 times a second.

Marconi Instruments
(02) 638 0800

Video Over UTP

Network specialist allNet Technologies has released a new product from AT&T which allows the transmission of full motion colour video over unshielded twisted pair wire.

The new 380A series adaptor is equipped with an 8 conductor/8 position modular jack, two standard RCA jacks and a BNC jack. The 8 position modular jack connects the adaptor to the unshielded, twisted pair wiring of Systimax SCS, PDS, or IBS via the information outlet at the workstation location using Level 2 through 5 patch leads.

The BNC jack connects the baseband video equipment's video signal, while the two RCA jacks are used for connecting the audio signal.

allNet Technologies
(02) 417 4800

Wireless Networking

Datamatic has announced the Australian release of two wireless LAN adaptors — RangeLAN/PCMCIA and RangeLAN/Parallel — for the Proxim family of wireless networking products. RangeLAN/PCMCIA fits into a Type II slot of a notebook PC, while the RangeLAN/Parallel provides wireless connectivity to any PC via the parallel port. Also released was the new Roaming-For-RangeLAN software to be used in RangeLAN adaptors. The software allows seamless movement from one server location to another.

Datamatic (02) 449 8133

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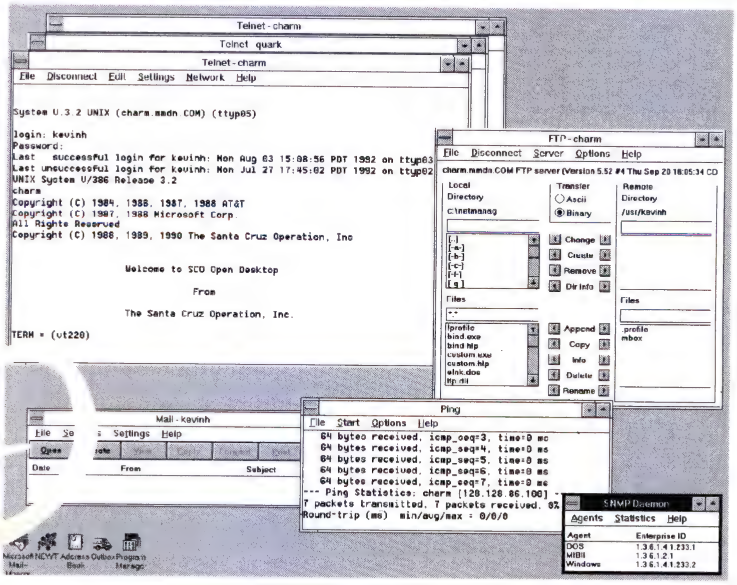
(TCP/IP, FTP, SMTP) ONC RPC/XDIR,
SNMP API.



Telnet - charm

```
System U.3.2 UNIX (charm.mmdn.COM) (ttyp05)

login: kevinh
Password:
Last   successful login for kevinh: Mon Aug 03 15:08:56 PDT 1992 on ttyp03
Last unsuccessful login for kevinh: Mon Jul 27 17:45:02 PDT 1992 on ttyp02
UNIX System V/386 Release 3.2
charm
Copyright (C) 1984, 1986, 1987, 1988 AT&T
Copyright (C) 1987, 1988 Microsoft Corp.
All Rights Reserved
Copyright (C) 1988, 1989, 1990 The Santa Cruz Operation, Inc

                    Welcome to SCO Open Desktop

                                From

                    The Santa Cruz Operation, Inc.

TERM = (vt220)
```

FTP - charm

charm.mmdn.COM FTP server (Version 5.52 #4 Thu Sep 20 18:05:34 CD

Local Directory: c:\netmanag
Transfer: ○ Ascii ● Binary
Remote Directory: /usr/kevinh

Local files: lprofile, bind.exe, bind.hlp, custom.exe, custom.hlp, elnk.doc, ftp.dll
Remote files: .profile, mbox

Ping

```
  64 bytes received, icmp_seq=3, time=0 ms
  64 bytes received, icmp_seq=4, time=0 ms
  64 bytes received, icmp_seq=5, time=0 ms
  64 bytes received, icmp_seq=6, time=0 ms
  64 bytes received, icmp_seq=7, time=0 ms
--- Ping Statistics: charm [128.128.86.100] -
7 packets transmitted, 7 packets received, 0%
Round-trip (ms)  min/avg/max = 0/0/0
```

SNMP Daemon

Agent	Enterprise ID
DOS	1.3.6.1.4.1.233.1
MIBII	1.3.6.1.2.1
Windows	1.3.6.1.4.1.233.2

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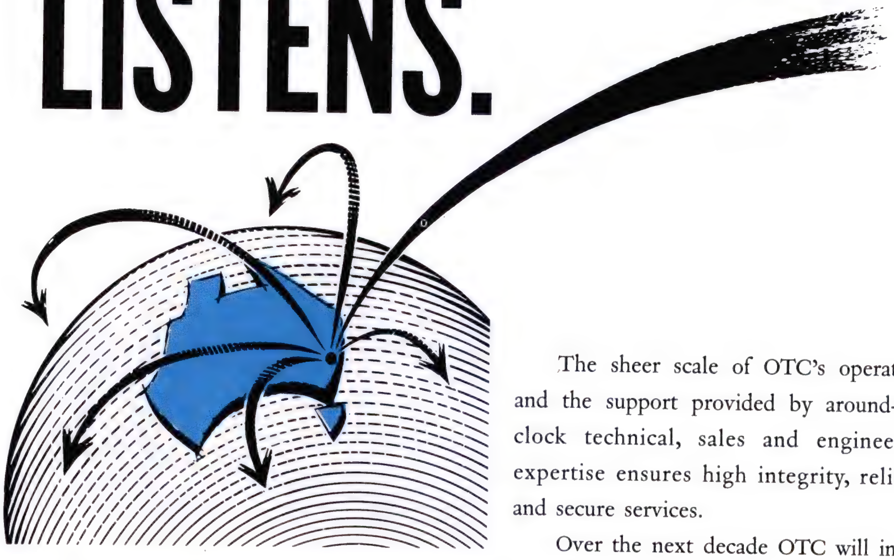

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The Paradox of Competition: It Can't Happen Without Strong Government

The central paradox of telecoms liberalisation, wherever it may happen, is the central and necessary role of a strong, usually unitary, government structure. Deregulation, liberalisation, and competition means in some ways more government, not less. This is the finding of the winning paper of the 1992 Pacific Telecommunication Council Research Prize — an annual award given to the best paper on international telecommunications issues.

This year's winner, announced in October at the PTC's Planning Meeting and Seminar in Auckland, is Mr Ben Alfa Petrazzini, a PhD candidate at the University of California at San Diego. Mr Petrazzini's paper is entitled 'The Politics of Telecommunications Reform in Developing Countries: Asia and Latin America in Comparative Perspective.' An Argentine national with wide experience in the region and a solid theoretical grounding, Mr Petrazzini is uniquely qualified to highlight a few under-recognised home truths.

The most successful, rapid, and dramatic liberalisations have taken place in non-federal, unitary states. Examples include Japan, Britain, New Zealand, and Chile. In each case, the governing party has been in a solid enough position to achieve its goals, not just vis-a-vis the national parliament but within the various contending special interests, groups, and opponents. Moreover, in cases such as New Zealand, Malaysia, and Chile, the national economies and stable political environments were favourable to foreign investment. Petrazzini identifies two key factors:

- The degree of power concentrated in the 'executive branch' of the state; and
- The relative autonomy of the state vis-a-vis political pressures.

These points explain the success of liberalisation in Malaysia and Mexico, and the relative failure of such initiatives in Argentina and Thailand. To an extent, they also explain why it has taken Australia and especially Canada a great deal longer than New Zealand or Britain to get to the same point.

> *"Australia has progressed more quickly than Canada, in part because telecommunications in Australia is provided on a national basis."*

Australia and Canada must contend with federal systems that diffuse power between federal governments and state or provincial governments. At each step of the liberalisation process, the federal-state or federal-provincial dimension must be painfully and critically examined. Australia has progressed more quickly than Canada, in part because telecommunications in Australia is provided on a national basis, unlike Canada's collection of provincial and regional carriers.

But weren't the Americans the first to liberalise, within a federal country with strong regional interests — and regional carriers within the AT&T network? Yes, but the American experience supports Petrazzini's point. The liberalisation of American telecoms was possible because of (1) clear federal authority; (2) clear political support from the executive; (3) a single telecoms provider to be liberalised and divested (AT&T); and (4) stable governmental regulatory structures that guaranteed adequate supervision of the liberalisation process. American States have much less power than Australian ones, or than Canadian Provinces. Moreover, as in New Zealand, the political movement towards telecom liberalisation in the US took place at a time when the government of the day enjoyed relative popularity and goodwill. The government had the mandate to undertake such action. In Canada, the liberalisation process is taking place at a time when the government is so unpopular, *any* action — even from the independent regulator — is destined to encounter strong public opposition. As the title of his paper suggests, Petrazzini centres on the experiences of developing countries attempting to liberalise telecommunications. Given the diversity and unique qualities of the liberalisation process in the developed countries, developing countries have had to adapt the models of the US, UK, New Zealand, Australia, Japan, etc., to their own national situations.

The evolution of open BTO (build-transfer-operate) or BOT (move about the same words) processes is one way to accommodate new players into the national network whilst improving that network. This strategy has met with some success in Thailand, and the Thai cellular, paging, and data markets have been liberalised. The growth of cellular in particular has been harnessed by business to supplement and often substitute for the creaky CAT (Communications Authority of Thailand) and TOT (Telephone Organisation of Thailand) national networks. As Petrazzini states, 'bad planning, financial constraints, managerial and technical problems, lack of coordination between CAT and TOT, and an average installation charge of approximately $US1,000, surprisingly have not slowed the rapid growth of telecom services in the country . . .'

Given the dynamism of the Thai economy, the inability to liberalise Thailand's large telecoms duopoly (in fact, two regional monopolies) really relates back to the two central points noted above. As Petrazzini explains, 'the reform process in Thailand has shown that a low degree of state autonomy and a dispersed state power structure made it very difficult for successive governments to privatise TOT or CAT. The inability of the executive to pull together a large enough party coalition to introduce legislative reforms in the sector was a key element in the failure, coupled with the strong opposition of state officials, telephone workers, and certain sectors of the military, it is not surprising that the privatisation programmes were cancelled despite long-term government commitment to their success.' Petrazzini argues that Thailand has achieved a modicum of liberalisation through the sheer brute force of such a dynamic economy. He maintains that economic strengths have allowed private entities to crash through the barriers of political inaction and complexity. But only to a certain point, beyond which government action and authority is required.

Petrazzini concludes by asserting that, for developing countries, free market economies and participatory politics do not go hand-in-hand. In fact, economic liberalization may be better suited to more authoritarian forms of governing. In developed states, the acknowledged and responsible power of elected parliaments, executives, etc., enables economic liberalisation to take place, but only when the conditions are favourable and not always in a particularly rapid manner. Whether in developed or developing states, legitimate political power and political will is necessary for telecommunications to liberalise.

What does this tell us? That one needs strong governments in order to reduce the role of government, among other things. Petrazzini's paper is a gold mine of information for those seeking to understand how, when and why governments liberalise telecoms.

James Savage is the Assistant Director, Pacific Telecommunications Council and Editor of Pacific Telecommunications Review.

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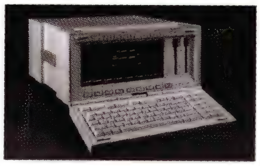

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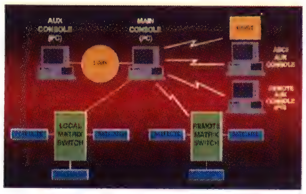

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LAN/WAN ANALYSER

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ETHERNET

WAN: ISDN
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TRANSEND
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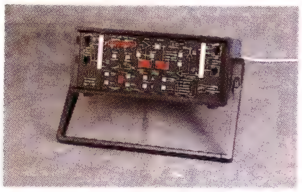
SNA

PROTOCOLS:

X.25, SNA, HDLC, SDLC, SS7, Q921/Q931, XNS, TCP/IP, NETBIOS, NETBUI, ISO, APPLETALK, MBI, DECNET, SUNNFS, X-WINDOWS, SNMP.

SIMULATORS



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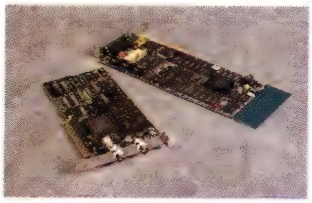

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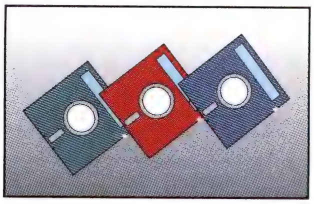

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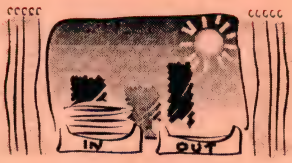

From the desk of the Executive Director

Radiocommunications Reform at Last

A new bill to provide for the management of the radio frequency spectrum entered the Parliament on November 12. The consequent *Radiocommunications Act 1992* will be the instrument governing the sector, taking over from the *Radiocommunications Act 1983,* which was seriously in need of revision. The bill sets up new arrangements for frequency spectrum planning and marketing, licensing, setting standards, regulating interference problems and conformance testing. A major change is the setting up of a Spectrum Management Agency (SMA) and the appointment of the Spectrum Manager.

ATUG will make the new Act available to its members on a fully-searchable diskette, in the same way as it has all the other current telecommunications legislation.

Radiocommunications Consultative Council

In order that the industry and users provide input to these new arrangements DOTAC has formed a Radiocommunications Consultative Council, whereby most interested parties, including ATUG, are represented. Chaired by Deputy Secretary Mike Hutchinson, this council will provide a very good opportunity for users to keep abreast of and have a say in the development of radiocommunications policy.

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Unit 3, 8-12 Sandilands Street
South Melbourne, VIC, 3205
Australia
Tel: (03) 690 6395
Fax: (03) 699 9094

In an encouraging opening statement, Hutchinson made the point that this was to be a truly consultative forum: "Meetings will no longer be at the department's choice and the department's agenda. The council is here for the long haul, to be responsive to users and the users' needs." Music to our ears of course and another welcome sign of the ongoing desire for consultation shown by the department over the last three or four years. One area that the council will not consider though is the matter of spectrum allocated under the *Broadcasting Services Act*. That's a matter for the Australian Broadcasting Authority.

Although this is a completely revised bill with many changes to existing arrangements, perhaps the three most significant areas of change are in the:

- Marketing of some parts of the spectrum;
- Facilitating the conformance testing and certification of equipment; and
- Formation of the SMA.

Marketing Spectrum

The recommendation to open parts of the spectrum to the market came from the report of the House of Representatives Standing Committee on Transport Communications and Infrastructure (HORSCOTCI). The Minister will have the authority to declare specified parts of the spectrum to be available for commercial spectrum licences, which could be allocated either by auction, tender or for a predetermined or negotiated price. Trading in spectrum licences will be allowed.

Licences for safety and community services such as ambulance, fire and safety of life services associated with aviation and shipping will, of course, be reserved to those services and not made available to the market. We have been assured that there will be no additional charges for frequencies supporting these services.

Technical Issues Facilitated

The SMA will manage the standards and conformance testing aspects. There seems to be a heartening desire to adhere to international standards where possible and arrangements for self-labelling of equipment and compliance certification are potentially simpler and less expensive processes than before.

SMA — The Austel of Radio Spectrum?

It will be seen by some as incongruous that we shall have two telecommunications-related authorities, doing similar work in regulation, standards and conformance testing. But DOTAC has traditionally owned both policy and regulation in the radio area and that it is the way it will stay. 'Fair enough — see how the SMA goes' seems to be the general reaction. It will be reviewed in 1995.

SMA will be set up by 1 July 1993 and be headquartered in Canberra, with a staff of about 400, taking with it about a quarter of the Department. The Spectrum Manager will be at Secretary level and one of the manager's first tasks will be to enquire into fees for licenses and the requirements for licensing. The backbone support system for the SMA will be the Radcom Computer Project which will also take on virtually the whole of the DOTAC information management system.

This is a time when those closely involved in radio spectrum matters need to keep their ears close to the ground. In particular they need to be ready to put their hands up when the Minister releases frequency bands to the market.

Wally Rothwell
Executive Director

Telecommunications in Queensland

Queensland is currently enjoying healthy economic growth at a time when the rest of Australia is feeling the recession's pinch. A number of new businesses are being established in the sunny State and telecommunications has become an issue. Hence, the ATUG Queensland committee took the opportunity and held a one-day seminar and exhibition to give users an update on the new deregulated telecommunications marketplace. The event was well attended and an extensive panel of speakers participated. The event was also televised to Queensland's regional areas via TSN 11. The live broadcast also reached parts of the Northern Territory. The following summarises the main points discussed during the day on how users may benefit from telecommunications deregulation.

As a State, Queensland is clearly a driving and growing force according to AOTC's Corporate, Government and International Managing Director, Steve Burdon. He said Queensland's growth would be largely driven through the nineties by the traditional areas of resources, tourism and agriculture but telecommunications and information technology would also play a key role in supporting this growth.

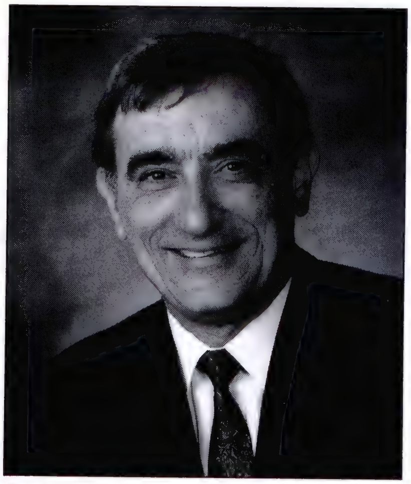
To participate in the State's growth, AOTC has established its national consumer division office in Brisbane and is making significant investments in Queensland's infrastructure. For example, its current infrastructure development in Queensland includes a $300 million capital investment program for 1992/93 of which $40 million is for the provision of a 1,612km optical fibre cable network. "This will connect with the existing 4,500km network linking the capital cities of Australia. The optical fibre coastal link from Brisbane to Cairns has been installed and we have also started an inland parallel route back to Brisbane from Cairns," Burdon said.

Queensland's telecommunications infrastructure, research and development facilities, skilled information technology workforce, taxation incentives and lifestyle are viewed as valuable qualities to enhance Australia's position as the country for multinationals to establish their Asia-Pacific regional headquarters. "A key element in regional headquarters is the telecommunications network which enables these corporates to link into the diverse Asia-Pacific markets and communicate with their head office. The regional headquarters act as a hub, a cen-

Queensland Government Benefits From Deregulation

One very large user of telecommunications services quick to act on the opportunities that the deregulated marketplace can offer is the Queensland Government. It expects to reduce its phone bill by $90 million over the next five years following its appointment of a 'telecommunications broker' to manage its $100 million a year of telecommunications services. In August this year, the Queensland Government signed a contract with Queensland-based Pacific Star Communications for it to be the preferred supplier for telecommunications facilities management services. It is owned by Bell Atlantic and Telecom Corporation of New Zealand Limited and uses the slogan 'leading the future in Australian telecommunications.' With this in mind, Pacific Star appointed the Queensland-based company, Queensland Network Services (QNS), to act as the official telecommunications equipment broker for the contract.

Pacific Star is providing facilities and management services to the Queensland Government's internal communications network negotiating all voice, data, facsimile and audio-visual service and equipment needs. According to the Queensland Government's Administrative Services Department's Telecommunications General Manager, Fred Nicolosi, Pacific Star's main task is to aggregate telecommunications demand from all the Government departments and agencies so that the best services/price conditions can be negotiated from the suppliers.



Fred Nicolosi, General Manager, Queensland Telecommunications (Q-TEL)

Handling the facilities management services for Pacific Star is its wholly-owned subsidiary, SunNET. The only physical infrastructure that Pacific Star and SunNET are expected to provide as part of the contract is the OSS. All other equipment and services are expected to be sourced from carriers and service providers. The Queensland Government's network links agencies and departments which are spread over more than 60 major locations and has 60,000 users. The network also links to the current public telecommunications providers AOTC and Optus (see diagram on page 3).

As a facilities manager, Pacific Star expects to:

- Reduce the Queensland Government's telecommunications costs;
- Manage the quality of service to users; and
- Support local industry and develop a strong locally-based telecommunications company with professional staff applying international best practice standards.

The services which Pacific Star bring to the Queensland Government includes voice, data, mobile radio and cellular. In particular, the voice and data services include: ISDN; advanced intelligent network; synchronous digital network services; centex services; videoconferencing; digital PABX; wide area networking; broadband ISDN with ATM; common channel signalling system #7; encryption service; virtual private networking; frame relay switching; voice messaging; metropolitan area networking; digital microwave; fibre optics; and very small aperture terminal (VSAT).

The mobile radio and cellular services are made up of UHF and VHF land, mobile service, cellular service, high frequency, maritime service, paging, and personal communications number.

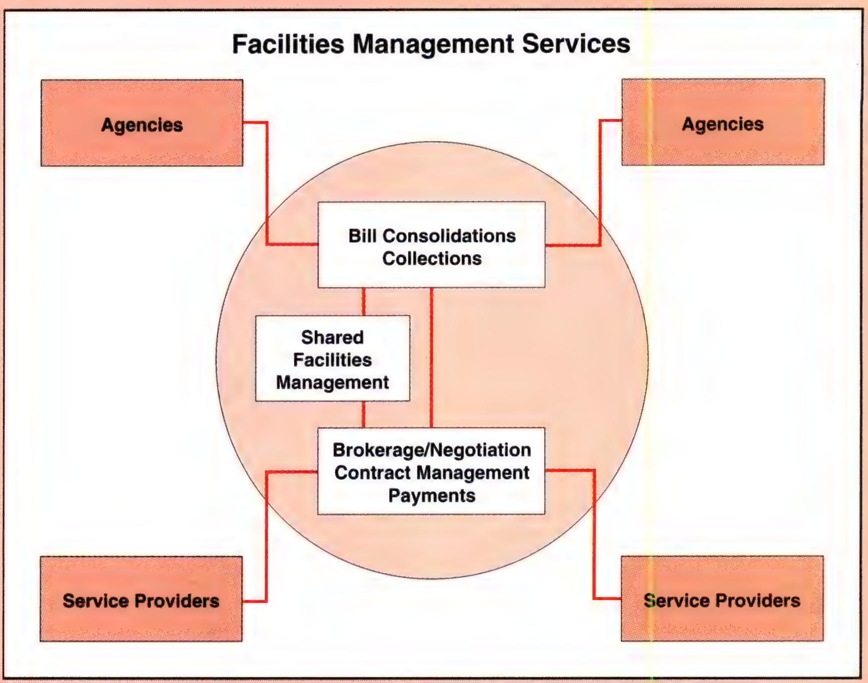
tralised point aggregating and dispersing communications," Burdon said. The Sheraton Hotel is an example of a multinational organisation which has established its Asian Pacific regional telecommunications hub in Brisbane.

Benefiting From Deregulation

One benefit for users from the telecommunications marketplace is the release of the Integrated Services Digital Network (ISDN) service according to Jtec's Queensland Manager, Lew Laing. He said the move to ISDN offered users substantial savings without the requirement to change any current equipment. For example, the cost of a local call of two minutes may be reduced by up to 30%. On STD calls, up to 24% savings may be made except for the 50 to 85km billing distance which is more expensive.

"To take advantage of this tariff difference it is quite clear you must connect your telephone service onto the ISDN network to reap the benefits of the preferential tariff already available, retaining some of the calls through the old PSTN network for long held local calls and for those calls between 50 and 85km." Laing said. He recommended users to consider a PABX with the least cost routing as this could be very easily set up with tables to direct the calls out through ISDN or through the Public Switched Telephone Network (PSTN). Another benefit for users are the Digital Data Services. According to Laing these services offered potential for performance in terms of bandwidth available and in terms of savings. "The real payback for the Digital Data Service replacement is to integrate voice with the data if a higher bandwidth is not required by the data processing department. This means that you can install some voice tie lines for the same operating costs as your Digital Data Network (DDN) service today," he said. Laing gave the example of the transmission cost for a 9.6Kbps DDN line being around the same for a 64Kbps ISDN service.

The third benefit is virtual private networking. "As a very rough rule of thumb you can assume if you have a data network of just about any type running on DDN or have conventional voice grade tie lines running on the analogue service then you can provide additional services such as voice and data for the same operating costs," Laing said. Other benefits offered by deregulation may be classified as 'strategic advantages.' One such advantage is to install a system capable of handling D Channel Signalling and using the ISDN network in the way it was intended to be used. Another strategic advantage is choice and price. "The two carriers will have an ISDN network. Both carriers will obviously provide a broad platform of applications which will be the same and the competitive edge will come from pricing and service differences," Laing said.


Facilities Management Services

Personal Communications

The topic of personal communications was discussed by Ericsson Australia's Marketing Manager for Business Cordless Telephony, Les Williamson. He said the vast cellular-based networks were now offering a more 'personal' service helped by the introduction of small and lightweight, yet technically efficient, handsets and other communication devices. "However, to utilise these ever developing sophisticated networks, the potential user must enter into the terminal market and purchase a suitable terminal, be it for voice, data or a mixture thereof. This challenge has been met successfully in certain markets but with cellular penetrations just edging into 8% in some markets in 1992, obviously it cannot be stated that we as an

AAPT Switching in Queensland

The telecommunications service provider, AAP Telecommunications (AAPT), took the opportunity of the ATUG Queensland event to announce that it would be completing the installation of a switching point on the Gold Coast this month. This makes the Gold Coast the first regional city on the AAP Telecommunications network. Over the next few years, other regional cities will be progressively connected to the network according to AAP Telecommunications General Manager, Bill Egan. He said cities such as Newcastle and Wollongong in NSW, Ballarat and Geelong in Victoria, Launceston in Tasmania, and Townsville, Rockhampton, Cairns, Toowoomba and the Sunshine Coast in Queensland will also be included.

Another first to be announced for AAPT was the installation of its first toll switch in Sydney and its connection to the MCI intelligent network data base in the US. "This database is used for all MCI's intelligent network services, including its virtual private network, Vnet. This connection allows the special features available as part of the AAPT's virtual private network, Vantage, to be provided to our customers here in Australia," Egan said.

A second toll switch is currently being installed in Melbourne. This will be followed by further installations in Brisbane and the other capital cities. AAPT also provides international services to all countries around the world. "Direct connect arrangements have been put in place with New Zealand, and will be followed by links to other major destinations such as the US, UK and our South East Asian neighbours," Egan said.

industry have fulfilled the visions of personal communications," said Williamson. He added that the ability to successfully provide personal communications lay in the network infrastructure and in the ability for a service or feature to be carried over several telecommunication network parts. "The concept of 'overlaying' the existing installed base with more advanced 'blanket' networks to provide a personal communications service is already being investigated commercially by many administrations around the world, and in the majority of cases this concept is being spearheaded by recent developments in the area of cellular telephony networks," he said.

The concept of total mobility has instigated much debate in the telecommunications industry and remains relatively undefined. "The concept of mobility has been discussed at great length, and the general consensus is that it should represent 'a single distinguishing number string, a single or specifiable billing address, with the ability to be located at any time at will, and likewise originate contact at any time at will, by the most appropriate and convenient method at that given moment.' This is a tall order for the industry as a whole, and it is only when these basics are covered that true personal communications can begin to be developed and offered. However, many existing and soon to be launched networks, mechanisms and products are leading us along the mobility path and very rapidly," Williamson said.

Personalised billing and 'one number' access codes from anywhere in the world are examples of the mobility concept. "Cordless networks based on Cordless Telephone (CT-2) for public access, CT-3 and Digital European Cordless Telephone (DECT) for business access, CT-1 for domestic or a combination of all of these are also helping to ready the marketplace for future radio-based devices to be used for communication needs," Williamson said.

The control and intelligence required for these networks have already been tabled in many standardisation bodies around the world and centre on the concepts of the intelligent network, along with other mechanisms which are currently being standardised such as smart card developments, card reading terminals, databases, Home Location Registers (HLR's) and Visitor Location Registers (VLR's), along with the harmonisation of international and national numbering schemes. "These will all combine and mature to develop into 'the' basic infrastructures for all competitive telecommunication networks around the world," Williamson said.

Toula Mantis

A Matter Of Choice

On the issue of choice, Telecommunications Consultants' Queensland Manager, Peter Thompson, said telecommunications users were more in tune with the need to optimise their use of existing services and equipment rather than upgrading to completely new systems. "The ability to more accurately assess the way companies and organisations handle internal communications as well as how they exchange information with their marketplace is a key element in making an informed choice between competing telecommunications products and services," he said. As a warning to equipment and service providers Thompson turned to history to demonstrate the need for the user's voice to be heeded. He said that features and facilities offered by customer premises equipment suppliers had remained virtually unchanged from the 1970s.

"Unless service and equipment providers begin listening to users instead of selling 'user-unfriendly black boxes' as they were in the 1970s they will miss the opportunity of customising technology to meet the real expectations of telecommunications users," he said. Thompson gave the example of Centrex saying that it offered the same types of services bundled together with the basic public network access lines only it was marketed and priced differently.

He also pointed out the confusion in the marketplace following deregulation and the merging of technologies. "The merging of technologies for voice, data, text usage highlight the increasing irrelevance of separate telecommunications, radio communications and broadcasting policies and legislation. Deregulation has brought with it significant levels of re-regulation and many observers would also ask what benefits are really being achieved for users in what appears to be a confused marketplace. Policy makers too need to do more listening to users and to legislate accordingly," Thompson said.

Get Your Copy Of
The ATUG Queensland Video:

"How to benefit from telecommunications deregulation"

ATUG in association with TSN 11 are proud to offer the ATUG Queensland event on VHS video for ATUG members. The video covers the televised broadcast and runs for three and a half hours. It is hosted by Andrew Carroll, former producer of *Beyond 2000, The 7.30 Report, Four Corners, The National* and *This Day Tonight.*

It covers the presentation made by the keynote speaker, Robin Davey, Chairman for the Australian Telecommunications Authority (Austel) as well as the following:

- 'ISDN — a choice of digital network' by Jtec's Queensland Manager, Lew Laing;
- 'Alternative network services' by QNET's Managing Director, Rick Strangman;
- 'Service providers — a better deal for Queensland business?' by AAP Telecommunications General Manager, Bill Egan;
- 'A new era in telecommunications' by Optus Communications' Director for Sales and Marketing, Cleve Whatley;
- 'AOTC's commitment to telecommunications users' by Telecom Australia's Corporate, Government and International Managing Director, Steve Burdon.

It also includes short interviews with ATUG's Chairman, George Maltby, the Telecommunications General Manager for the Queensland Government's Administrative Services Department, Fred Nicolosi; Pacific Star Communications Pty Ltd's Managing Director, Michael Begun; Ericsson Australia's Marketing Manager for Business Cordless Telephony, Les Williamson; Voxson Sales' Managing Director, Lucas Longinou; Telecommunications Consultants' Queensland Manager, Peter Thompson; and ATUG's Executive Director, Wally Rothwell.

The cost of the video is $60 (plus sales tax where applicable) which includes postage and handling.
To order your copy contact
ATUG in Sydney on (02) 957 1333.

January 1993

17-20 **PTC'93**, Sheraton Waikiki Hotel, Honolulu, Hawaii. PTC'93 will look at political, social, economic and technological issues. The theme for the 1993 exhibition is 'Harnessing Converging Telecommunications Technologies for Societal Applications.' The 15th annual Pacific Telecommunications Council conference, PTC'93 will look at the utilisation of converging technologies and will feature leading and key commentators on virtually every telecommunications topic of importance to the Asia/Pacific/Americas region. Dr Theodore Irmer, Director, CCITT, International Telecommunication Union (ITU), will head the list of key speakers. Enquiries — Pacific Telecommunications Council Tel: +1 808 941 3789 Fax: +1 808 944 4874.

18-21 **MECOM '93**, Bahrain International Exhibition Centre, Bahrain. The 7th Middle East Electronic Communications Show and Conference will feature a broad range of technology appropriate to the Middle East's communications industry whose combined budgets are expected to reach $US6.5 billion annually by 1995. Enquiries — Bill Hare, Australian Exhibition Services Tel: (03) 867 4500 Fax: (03) 867 7891.

February

1-4 **ComNet**, Washington D.C. ComNet is North America's largest trade show for networking and communications, with a floor show featuring over 450 exhibiting companies. The conference will look at the latest networking trends and technologies. Keynotes by Robert Metcalfe, the father of Ethernet, and Victor Pelson, President of AT&T, will accompany over 100 hands-on workshops, in-depth tutorials and topical sessions. Enquiries — ComNet '93. Tel: +1 800 225 4698 Fax: +1 508 872 8237.

15-16 **EIS: Information Delivery for Quality and Service**, Marriott Hotel, Sydney. This conference will look at the information and skills needed to implement an Executive Information System to track non-financial performance. Organisations including Dulux, Prospect Electricity, Tubemakers, Credit Union Services, Carlton & United Breweries and the NSW Police Service will deliver case studies on their use of an EIS. International user, Walter Dempsey, Manager, Business Management, Commercial Engine Business, Pratt & Whitney (US) will explain how its customer-focused EIS transformed the way the company did business. This conference is also being held at the Parkroyal Hotel, Melbourne 18-19 February. Fee: $1,195. Enquiries — AIC Tel: (02) 235 1700 Fax: (02) 223 8216.

16-17 **The 1993 Pan European Digital Cellular Radio Conference,** The FIL Congress Centre, Lisbon, Portugal. This seventh conference titled 'GSM Under the Spotlight — Focussing on the Users' will feature real life commercial GSM networks in place instead of trials, plans and promises. Emphasis is being placed on the users and objectives of the conference include: Examining the progress made in the manufacture and type-approval of GSM equipment and in the deployment of GSM networks in Western Europe; Indentifying the critical issues for the success of GSM including the likely impact of competing systems; and Examining the plans and prospects for GSM networks outside Western Europe. Enquiries — Tania Starley, IBC Technical Services. Tel: +44 71 637 4383 Fax: +44 71 631 3214.

17-19 **2nd Australian Conference on Telecommunications Software, (ACTS '93)**, Wollongong University, Wollongong. ACTS '93 will provide an opportunity for professionals in telecommunications and related industries to take an in-depth look at new opportunities for the development of telecommunications software. Australia leads the way in advanced ISDN and Intelligent Network services and new technology and new government policies will encourage the innovation of new services in telecommunications networks. The conference is aimed at users and providers of telecommunications and information services, telecommunications professionals, academics, planners and consultants. Enquiries — The Institute of Radio and Electronics Engineers Australia. Tel: (02) 327 4822 Fax: (02) 362 3229.

22-23 **Corporate and Government Customer Impact of Telecommunications Network Competition**, Sheraton-Wentworth Hotel, Sydney. At this conference delegates will hear Telecom, Optus and AAP discuss their strategies for 1993. Key Issues include: Quality, reliability and accessibility of telecommunications services; a practical analysis of the choices available under competition; securing customer support and maintenance; assessing the pros and cons of outsourcing; and how to negotiate the best competitive tariff, service, billing and pricing deals. There will be two international guest speakers: Arthur Slotkin, Vice President and General Manager Systems Support Operations, Unisys (US); and David Patten, General Manager Sales & Marketing, Clear Communications, (NZ). Fee: $1,295. Enquiries — IIR Tel: (02) 954 5844 Fax: (02) 959 4684.

22-25 **Intercomm '93**, Vancouver Trade & Convention Center, Vancouver, Canada. This Global Telecommunications Congress and Exhibition has the theme 'Global Communications for the 21st Century.' This conference boasts over 400 trade booths and over 1,000 delegates — over 7,000 exhibition visitors are expected. Enquiries — Helen Rowell, Canadian Consulate. Tel: (03) 654 1433 Fax: (03) 650 5939.

March

3-5 **The Pan-Asian GSM Summit**, Marriott Hotel, Hong Kong. Highlights of this Global Systems for Mobile Communications conference are: Problems and solutions for GSM coordination in Pan-Asia, Government policy, regulation and licensing for GSM, Commercial opportunities in GSM, Comprehensive analysis of GSM billing and account transfer, and How to get your products approved and marketed into Asia. An optional third day will focus on GSM technology, there will be presentations from seven European Telecommunications Standards Institute/Special Mobile Group (ETSI/SMG) Chairmen. Fee: All three days $US1,795. Two days $US1,295. Day three only $US895. Enquiries — IIR Tel: (02) 954 5844 Fax: (02) 959 4684.

8-9 **Mobiles 1993**, Golden Gate Park Plaza Hotel, Sydney. At this 4th annual conference, key decision makers from Asia, New Zealand and Australia will analyse mobile communications planning, regulation and opportunities in the Pan-Asian region. The latest developments in GSM, AMPs, and LEOs will be discussed and also competitive mobile services in Australia and spectrum allocation and management of Australia's mobile communications. This conference is specifically designed to study the latest advances, policies, deployment and views in digital communications. Presentations will be made by key players from DOTAC and France Telecom and other organisations. Fee: $1,295. Enquiries — IIR Tel: (02) 954 5844 Fax: (02) 959 4684.

8-10 **Hands-on Internetworking**, IIR Technology Centre, Sydney. This three-day workshop teaches participants to integrate existing LAN resources into WANs; maximise WAN productivity with OSI, assess the latest LAN extension devices to determine which will best suit your LAN needs, and also to understand the internetworking standards which affect LAN/WAN capability. This course is also being held in Melbourne, March 22-24. Fee: $1,695. Enquiries — IIR Tel: (02) 959 5455 Fax: (02) 959 4687.

24-26 **4th International Congress of EDI Users**, Conrad International Hotel and Jupiters Casino, Gold Coast, Queensland. Presented by the EDI Council of Australia, the central theme for the conference is 'Doing EDI, not talking EDI' and the aim is to address both the real and imagined reasons to overcome the current barriers to implementation. EDI is not complicated — it is the changes in business practices that cause the complications. Organisations need to develop their own EDI strategy and implementation plans, and they must establish links across their entire business pipeline. Enquiries — EDI Council of Australia. Tel: (03) 819 6860 Fax: (03) 818 3129.

April

19-22 **SuperComm '93**, Georgia World Congress Centre, Atlanta, Georgia, US. Presented by the United States Telephone Association (USTA) and the Telecommunications Industry Association (TIA), SuperComm '93 is the largest annual telecommunications event in the world. This year SuperComm '93 has been designated as a Foreign Buyer Show by the US Department of Commerce. The US & Foreign Commercial Service at the American Consulate General in Melbourne plan to lead an Australian Foreign Buyer delegation to SuperComm '93. Enquiries — Lois Logan, American Consulate General, Melbourne. Tel: (03) 526 5927 Fax: (03) 510 4660.

28-30 **Hands-on Ethernet**, IIR Technology Centre, Sydney. Participants will build a live Ethernet network, while learning key techniques for installing, operating and troubleshooting Ethernet networks. After attending the course participants will be able to grasp the fundamentals of networks, optimise Ethernet performance and deal with cabling, security and diagnostic tools. Fee: $1,495 Enquiries — IIR Tel: (02) 959 5455 Fax: (02) 959 4687.

May

10-13 **The 4th Joint European Networking Conference (JENC)**, Trondheim, Norway. Organised by RARE (Reseaux Associés pour la Recherche Européenne) and in association with other groups including the Internet Architecture Board and the Internet Society, this year's Joint European Networking Conference has the theme 'European Networking in a Global Context.' It aims to explore the steps regarding the fact that networks covering a specific geographical area or networks for a specific user group will only be successful if connected to the rest of the world. Enquiries — RARE Tel: +31 20 639 1131 Fax: +31 20 639 3289.

17-22 **Asia Telecom'93**, World Trade Centre, Singapore. As part of its four year schedule of events, the International Telecommunication Union (ITU) is presenting Asia Telecom 93 to provide a platform for the exchange of information for technological advancements, and technical, policy, economic and regulatory developments. The Asia region is the world's fastest-growing telecommunications market — there's space for 300 million more lines and for up to $US1,000 billion in investments in the next 50 years. The four Symposia of the Asia Telecom 93 Forum Policy, Technical, Regulatory and Economic is attracting the most influential players in national and international telecommunications. Enquiries — Suzan Hee-Sook Lee, Project Manager, Asia Telecom 93. Tel: +41 22 915 5811 Fax: +41 22 740 1013.

The Re-Regulated Market

Before users may take advantage of the deregulated marketplace they must first be able to understand the new environment or the 're-regulated' market according to Austel's Chairman, Robin Davey. He took the opportunity of ATUG in Queensland to explain that users must have an understanding of the structural and regulatory framework before they can take advantage of any competition in the market. Davey added Austel could only go so far in ensuring that its fine tuning of the basic structural and regulatory framework laid a true foundation. "It is for the players to take advantage of the competition," he said.

Timetable To Competition

According to Davey, Australia is on target based on the timetable set by the Australian Government's November 1990 statement for duopoly competition in 1992 as an interim measure pending full competition in 1997. That is, the necessary legislation was passed through Parliament and came into operation on 1 July 1991.

The selection of Optus as the second carrier based on a privatised Aussat was also made on schedule in November 1991. Further, the carriers, AOTC and Optus, have negotiated their interconnection and access arrangements. Optus has commenced its mobile service on schedule in mid-June 1992 (reselling airtime on the incumbent AOTC's MobileNet analogue cellular service and by mid-October 1992 it had signed up its 25,000th customer). Optus has also commenced its fixed network rollout and is on schedule to provide its fixed network long distance service in the final quarter of 1992 offering long distance services originating in Sydney, Canberra and Melbourne.

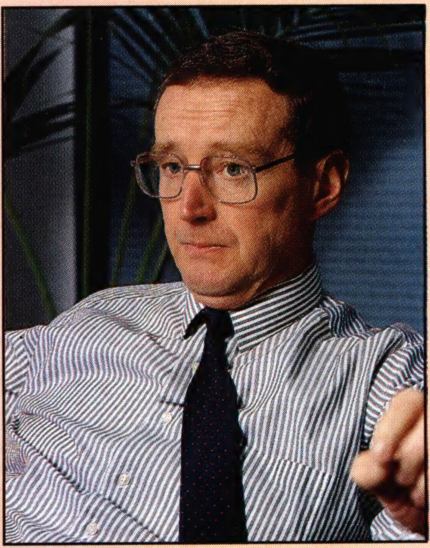
Customer access arrangements are in place so that callers in Melbourne, Canberra or Sydney wanting to use Optus' long distance service can simply dial '1' to select Optus instead of AOTC. After dialling '1' callers must then dial the full national number, including the long distance code of the person or organisation they wish to contact. For example, customers wishing to call Sydney from Melbourne will dial '102' followed by the number.

Licences To Enter Market

Austel has issued three class licences that enable any company complying with the conditions in the relevant licence to:

- Supply public access cordless telecommunications services;
- Make unrestricted use of services supplied by AOTC or Optus to resupply those services to another person using any switching facilities of their choice; and
- Engage in both domestic and international resale.

"The position reached by Australia is a logical progression of an evolution commenced by the Australian Government's May 1988 statement on telecommunications reform. It comes from, amongst other things, a desire to extract further efficiency from the industry by using more competition in the interests of consumers and in the interests of Australia's international competitiveness; and a belief that competition will be more effective if it is 'across-the-board' competition," Davey said.



Austel's Chairman, Robin Davey: "It is for the players to take advantage of competition."

The Structural Framework

The principal features of the current Australian telecommunications industry's structural framework are:

- A fixed network duopoly, licensed to supply a full range of domestic and international end-to-end services using all or any available technologies (The duopoly consists of a merged Telecom and OTC, known as AOTC, and Optus Communications. AOTC remains Government-owned whereas Optus is an Aussat-based private sector consortium of BellSouth, Cable & Wireless and significant Australian shareholders.);
- Both carriers have a mobile licence and are allowed to supply public access cordless telecommunications services under an Austel class licence;
- Full competition in public access cordless telecommunications services under the Austel class licence;
- A third mobile operator (to begin operations in the second half of 1993);
- Full resale of domestic and international telecommunications services under Austel class licences;
- An end to the duopoly in 1997; and
- A 'universal service obligation' to be shared among carriers on an equitable basis.

The Regulatory Framework

The central feature of the regime established to administer the current structural framework for the Australian telecommunications industry is Austel. It is a statutory authority independent of the carriers and subject to Ministerial direction only in specific instances. Its role is to act as a facilitator.

Austel's principal functions may be summarised as follows:

- The promotion of competition;
- The protection of consumers including the administration of price cap and price control arrangements;
- Managing the numbering of telecommunications services;
- Reporting to the Minister on competitive safeguards and carrier performance;
- Licensing;
- Technical regulation and setting of technical standards; and
- Administration of universal service levy arrangements.

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